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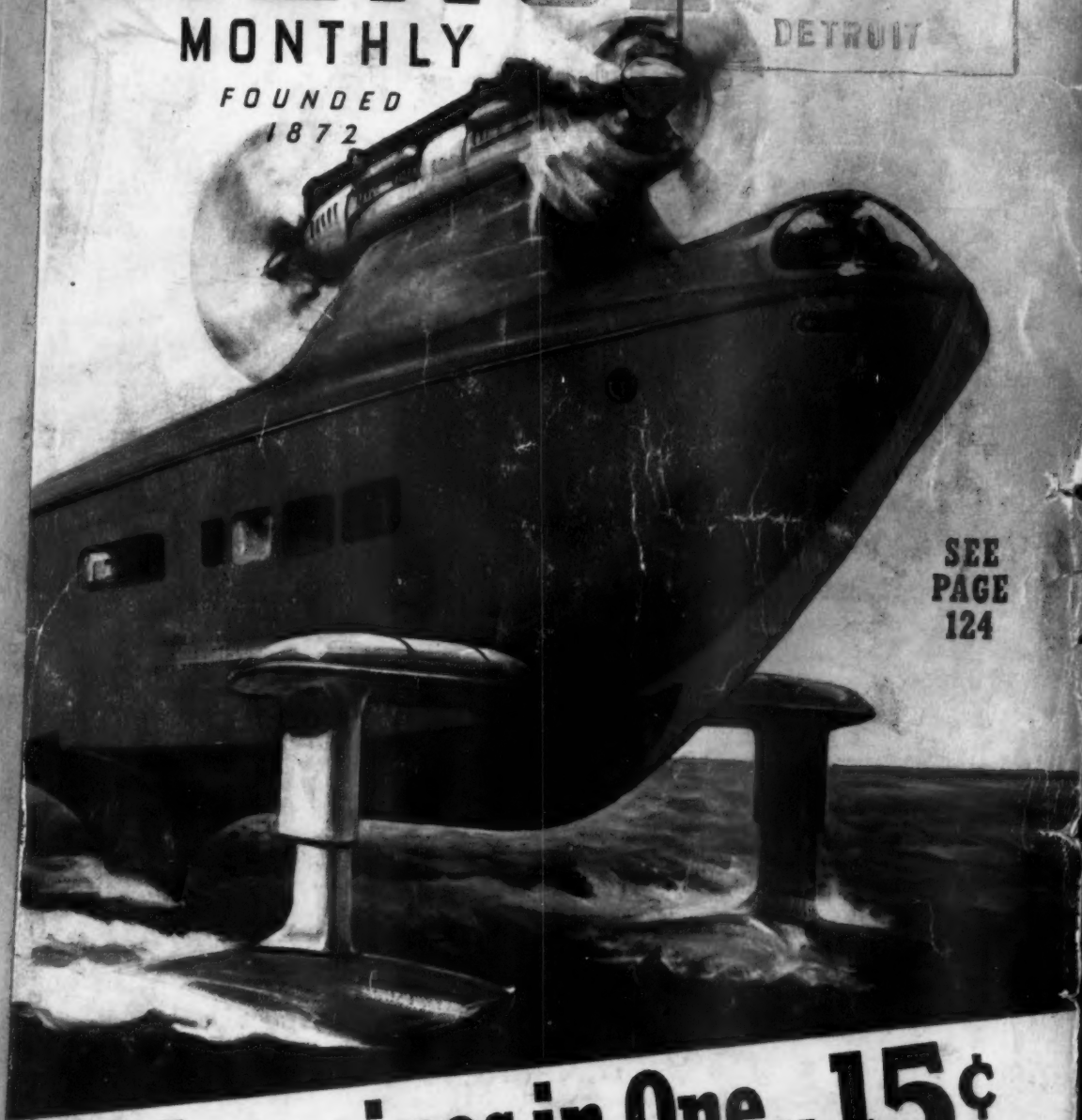

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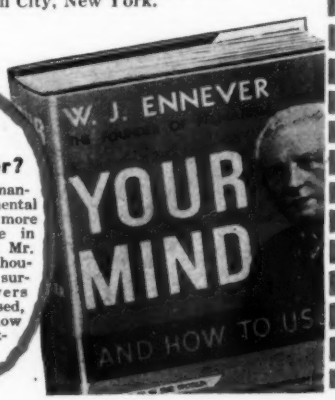

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Founded 1872
INCORPORATING Mechanics AND HANDICRAFT
Vol. 134 No. 4

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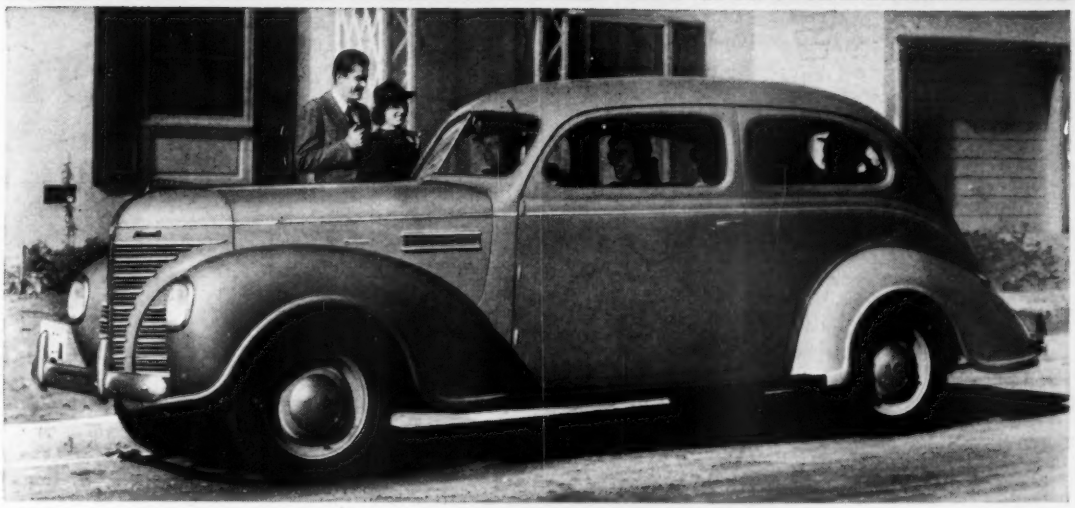

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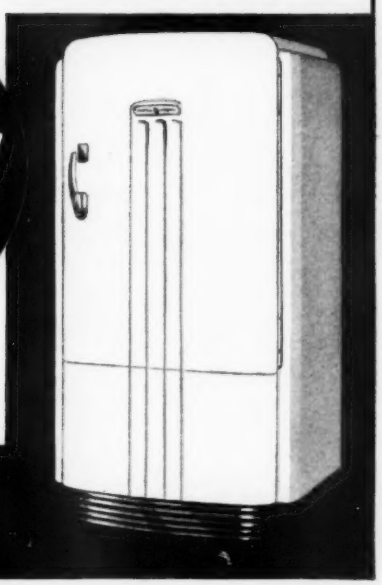

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THE AC HEAT RANGE SYSTEM:

WHAT IT IS, HOW IT WORKS, AND HOW TO MAKE USE OF IT

To give good performance, spark plugs must operate within a certain temperature range. *In relation to engine operating temperature,* they must "run" neither too hot, nor too cool.

If they run too Cool

—they will rapidly collect soot and carbon. These cause fouling and misfiring.

If they run too Hot

—the insulator may become encrusted, the firing points may wear rapidly, or the overheated plug may cause habitual pre-ignition.

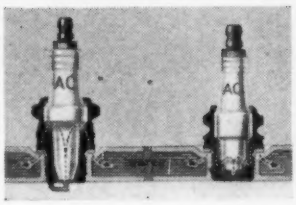
Through the AC Heat Range System, the temperature range of *any* AC plug can not only be predetermined but it can also be definitely charted. Once charted, that temperature range can also be designated. Thus, spark plug users can know, from the designation, the heat characteristics of one AC plug as compared with another. A shift to a cooler or hotter plug type becomes, consequently, a simple matter.

What's behind the numbering system? It's very simple.

AC uses numerals to designate the temperature range—and uses them like the graduations on a thermometer. A type 75 is hotter than a 74; and cooler than a 77. A 28 is hotter than a 26. A 44 is cooler than a 47.

The Basis of Heat Range

Spark plugs are cooled by radiation. The heat they take on travels up the insulator to the spark plug shell; from the shell to the cylinder block; from the block to the water in the engine jacket.



The illustration tells the story. → The short insulator cools faster because the heat travels a shorter distance to reach the spark plug shell. The long insulator cools slower because the heat travels a longer distance.

So, you can see that the heat range of an AC Spark Plug is mainly determined by the length of that part of the insulator up which the heat must travel.

Here's the Important Point

Only AC Spark Plugs are made in a heat range which is *complete* for all sizes of plugs.

If you find that your plugs *foul,* or become encrusted, firing points wear quickly or pre-ignition develops, go to any Registered AC Plug Cleaning Station and have the attendant see that you have the right plug type. It won't take five minutes—and correction *will* give you the engine performance you want.

Have the Plug Type checked while you're getting your spark plugs cleaned (cleaning costs 5c a plug)

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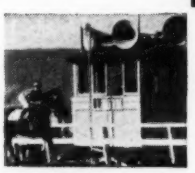
Fixing Radio sets in spare time pays many $5, $10, $15 a week extra while learning. Full time repair pays as much as $30, $50, $75 a week.



Loud Speaker Systems

Building, installing, servicing and operating public address systems is another growing field for men well trained in Radio.

Radio offers you many opportunities for well-paying spare time and full time jobs. And you don't have to give up your job, leave home or spend a lot of money to train to get these jobs—to become a Radio Expert.

Get Ready Now for Jobs Like These

Radio broadcasting stations employ engineers, operators, station managers and pay well for trained men. Fixing Radio sets in spare time pays many $200 to $500 a year—full time jobs with Radio jobbers, manufacturers and dealers as much as $30, $50, $75 a week. Many Radio Experts open full or part time Radio sales and repair businesses. Radio manufacturers and jobbers employ testers, inspectors, foremen, engineers, servicemen, in good-pay jobs with opportunities for advancement. Automobile, police, aviation, commercial Radio, loud speaker systems are newer fields offering good opportunities now and for the future. Television promises to open many good jobs soon. Men I trained have good jobs in these branches of Radio. Read how they got their jobs. Mail coupon.

Why Many Radio Experts Make $30, $50, $75 a Week

Radio is young—yet it's one of our large industries. More than 28,000,000 homes have one or more Radios. There are more Radios than telephones. Every year millions of Radios get out of date and are replaced. Millions more need new tubes, repairs. Over $50,000,000 are spent every year for Radio repairs alone. Over 5,000,000 auto Radios are in use; more are being sold every day, offering more profit-making opportunities for Radio experts. And RADIO IS STILL YOUNG, GROWING, expanding into new fields. The few hundred $30, $50, $75 a week jobs of 20 years ago have grown to thousands. Yes, Radio offers opportunities—now and for the future!

Many Make $5, $10, $15 a Week Extra in Spare Time While Learning

The day you enroll, in addition to our regular Course, I start sending Extra Money Job Sheets; show you how to do Radio repair jobs. Throughout your training I send plans and directions that made good spare time money—$200 to $500—for hundreds, while learning.

Here's How You Get Practical Experience While Learning

I send you special Radio equipment; show you how to conduct experiments, build circuits illustrating important principles used in modern Radio receivers, broadcast stations and loud-speaker installations. This 50-50 method of training—with printed instructions and working with Radio parts and circuits—makes learning at home interesting, fascinating, practical. I ALSO GIVE YOU A MODERN, PROFESSIONAL ALL-WAVE, ALL-PURPOSE RADIO SET SERVICING INSTRUMENT to help you make good money fixing Radios while learning and equip you with a professional instrument for full time jobs after graduation.

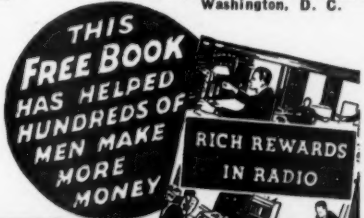
Money Back Agreement Protects You

I am so sure I can train you to your satisfaction that I agree in writing to refund every penny you pay me, if you are not satisfied with my Lessons and Instruction Service when you finish. A copy of this agreement comes with my Free Book.

Find Out What Radio Offers You

Act Today. Mail the coupon now for "Rich Rewards in Radio." It's free to any fellow over 16 years old. It points out Radio's spare time and full time opportunities and those coming in Television; tells about my training in Radio and Television; shows you letters from men I trained, telling what they are doing and earning. Find out what Radio offers YOU! MAIL COUPON in an envelope, or paste on a postcard—NOW!

J. E. SMITH, President
Dept. 9DP3, National Radio Institute
Washington, D. C.



HERE'S PROOF THAT MY TRAINING PAYS

$50 Monthly in Spare Time

"I work on Radio part time, still holding my regular job. Since enrolling seven years ago, I have averaged around $50 every month." JOHN B. MORISSETTE, 809 Valley St., Manchester, N. H.

Makes $50 to $60 a Week

"I am making between $50 and $60 a week after all expenses are paid, and I am getting all the Radio work I can take care of, thanks to N. R. I." H. W. SPANGLER, 126½ S. Gay St., Knoxville, Tenn.

Operates Public Address System

"I have a position with the Los Angeles Civil Service, operating the Public Address System in the City Hall Council. My salary is $170 a month." R. H. ROOD, R. 136, City Hall, Los Angeles, Calif.

This Coupon is Good for One FREE Copy of My Book

J. E. SMITH, President, Dept. 9DP3
National Radio Institute, Washington, D. C.

Dear Mr. Smith: Without obligating me, send "Rich Rewards in Radio," which points out the spare time and full time opportunities in Radio and explains your 50-50 method of training men at home in spare time to become Radio Experts. (Please Write Plainly.)

NAME ..... AGE .....

ADDRESS .....

CITY ..... STATE .....

Our Readers Say

If the Vernal Equinox Comes, Can Spring Be Far Behind?

FOUR times a year I am annoyed, and since one of these quarterly irritations is due in a few weeks, I am going to write and see what you can do about it. On March 21, the newspapers and nearly everybody else in the Northern Hemisphere will be saying that it is the "first day of spring." In the same way, they call the summer solstice (June 21) the "first day of summer"; the autumnal equinox (September 23) the "first day of autumn"; and the winter solstice (December 21) the "first day of winter." Now, it doesn't seem reasonable to me to say that summer, for example, begins at the summer solstice. From the astronomical point of view, which is the only point of view in which the summer solstice means anything, June 21 is the *middle* of our summer, because it is then that the earth reaches that point in its orbit when the north pole tilts most toward the sun. For the same reason, the vernal equinox is, astronomically speaking, the *middle* of spring, and so on for the other seasons. If we are going to use astronomical divisions for the seasons, let's give them their true astronomical meanings. Who'll join me in a crusade?—A.K.P., Buffalo, N.Y.

Spring Water Might Be Needed for Resiliency

CAN one of your readers answer this for me? Why not inflate tires with water instead of air? The added weight would tend to hold the car to the road, the tires would rarely have to be pumped up because water would not leak so freely as air, and the tires would not overheat. Last, but most important, the danger of blow-outs would be eliminated because, when a break occurred in a tube, the water would not rush out the way air does, and the driver could bring his machine to a safe stop. Congratulations on your cabin-cruiser plans. They're right up my alley. Let's have more of them.—W.R.S., Mount Vernon, N.Y.

Is a Star's Face Red? Maybe This Is Why

T.W.C., OF Montreal, wants to know why it is that some stars appear to be red. Here's the answer. One reason might be that the surface layer of such stars is largely composed of the gases of calcium, strontium, or potassium, all of which exhibit shades of red (and red lines on a spectrogram). The inert gas neon, as you can observe on any business street, also glows with a red light when ionized. It may also be that the star is much cooler than our own sun, in which case red might be the predominating color.—H.M.G., Austin, Tex.

With a Jitterbug Aboard, Some Swing Band Might Spell Disaster

WHY is it that no one has yet manufactured a compact radio receiver that will give broadcast reception inside the cabin of a transport plane? We have all kinds of vacation radios and traveler's sets that will work almost anywhere, but the airline commuter has to either hum to himself or listen to the snores of his fellow passengers. I understand one of America's foremost radio orchestra leaders, who is also America's No. 1 air passenger, has been looking for such a set for some time now without much success. Have POPULAR SCIENCE readers any suggestions to make on this vital matter?—D.M., New York, N.Y.

Shoot-and-Run Guy Wants More Space

ALTHOUGH a newcomer among your subscribers, I have been buying P.S.M. a long time on the newsstands. I recently subscribed just to see if it was any quicker in arriving each month. I wish you'd publish a lot more on photography. You could cut down on the space where you draw all those wires and figures and crooked lines, and so on, for the amusement of such persons as D.S., and the amazement of others like T.L. (September issue). Neither of them seems to appreciate your articles, but look at F.C.W. right below the two wranglers! So much for the bawling out, but please give us *(Continued on page 14)*

When jobs are looking for men —thats news!

1 Look here, Frank – Two full columns of male help wanted – your kind of work!
Yes I noticed it – Last year at this time there wasn't half that much
2 H'lo, Frank – you're an office man – Do you know where we could get a manager for our Accounting Department?
Gee – I wish I could qualify!
3 You say Mary's husband just got a new job at double his old salary? – That settles it, Honey – the time has come for us to get out of the rut, too. I'm going to write LaSalle tonight!
4 1 year later —
I stayed late at the office, Honey, to get off my last examination paper – now I'm somebody!
That's swell, Napoleon – here's a letter that came today
5 Honey, look at this! – We're out of the rut at last! Doberry & Co. want me to come and see them – just the job I wanted
And say – am I glad I'm prepared for it!

. . . . . NOW IS THE TIME! . . . . . .

RIGHT now, in many lines there is a search for really *good* men—managers, leaders—men who can take charge of departments, businesses, branch offices, and set things humming.

As always, there are not enough ordinary jobs to go round—but rarely before in the history of American business, has there been so much room at the *top!*

Ordinarily, there would be plenty of men to fill these jobs—men in junior positions who have been studying in spare time. But most men have been letting their training slide during these dark years of depression . . . "What's the use?"—You have heard them say. Perhaps there has been some excuse for sticking to any old kind of a job one could get the past few years—but the door is wide open for the man with ambition *NOW!*

And don't let anyone tell you that "Opportunity Only Knocks Once"—that's one of the most untruthful sayings ever circulated. Opportunities flourish for *every* American every day of his life.

Far more to the point is to be ready—be *prepared*—to make yourself *interesting* to the big-time employer—and, LaSalle offers you a short-cut method of qualifying for opportunity jobs in accounting, law, traffic, executive management, and kindred occupations.

LaSalle Extension is 30 years old—over 30,000 students enroll annually—60 American firms each employ 500 or more LaSalle-trained men—surveys show that average LaSalle students attain good salary increases after graduation—nearly 10% of all C. P. A.'s in the U. S. A. are LaSalle alumni.

Why not find out what LaSalle has done and is doing for men in *your* position? Send and get the facts; see what LaSalle can do for you personally!

There's no question about it—jobs are looking for *trained men*—the time has come for you to *qualify* for future prosperity. Mail this coupon today!

LASALLE EXTENSION UNIVERSITY, ***A Correspondence Institution,*** **Dept. 483-R, Chicago**

Kindly send me your free booklet on the business field I have checked—and tell me how your training in that field can help me.

☐ Business Management ☐ Business Correspondence ☐ Salesmanship ☐ Law ☐ Commercial Law
☐ Business English ☐ Traffic Management ☐ Accountancy ☐ Bookkeeping ☐ Stenotypy

Name ..... Position .....

Address ..... Age .....

LASALLE EXTENSION UNIVERSITY **A CORRESPONDENCE INSTITUTION**

Our Readers Say (CONTINUED)

shoot-and-run guys more space.—T.W.H., Lubbock, Tex.

P. S. M. Stole a March On Those Navy Preparations

READ tomorrow's news today—that seems to be P.S.M.'s new motto. When I read your article "Uncle Sam's New Ocean Empire," about eight months ago, I was interested, but didn't take the proposed development of our Pacific islands too seriously. Now, I realize that you were just about a half year ahead of the boys down in Washington. You certainly stole a march on the guardians of our Government, or perhaps they're saying, "We saw it in POPULAR SCIENCE."—J.L., New Haven, Conn.

It Was Simple, Unless You Felt Like Doing It the Hard Way

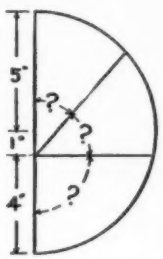
GEORGE'S weight—he's the lumberjack in the March "Readers Say" letter—is 196 pounds. By the conditions given, the log displaces its own volume and twice its weight of water. A moment's inspection should show that the weight of the lumberjack simply equals that of the displaced water, minus the weight of the log. The only figures needed are the log's weight and its specific gravity. Of course, you can arrive at the same result more laboriously by using the additional data given at the end of the letter.—P.R.T., Raleigh, N.C.

World's Smallest Park Got Pinched for Parking

As Visalia, Calif., was my home town, I'm qualified to say that the information given in "The Man with the Net" on page 139 of the February issue is not entirely correct. This smallest park in America, which consisted of a large oak tree growing in the middle of the main street, has been removed by order of the city council, as it was considered a traffic hazard, endangering the lives of careless motorists. Had the question of removal of this time-honored tree been put up to the vote of the citizens of Visalia, this beautiful tree, which can never be replaced, might still be the smallest park in America.—H.E.R., Compton, Calif.

Not Too Easy, Not Too Tough, Is the Way He Likes Them

THE problem submitted by W.S.L., Jr., in December was just right—not too easy and not too tough. Here is another offering for your readers' consideration. One half of a pumpkin pie is divided into three pieces of equal volume. If the pie is ten inches in diameter, and both cuts are made through a point one inch off center, how many degrees are in each angle?—L.P.B., Jr., Brooklyn, N.Y.



How To Check Up on That Check Problem

THE check problem submitted by W.W.J., in the February issue, can be worked by algebra, using two unknown quantities, one for the number of dollars and one for the number of cents in the check. One equation is easily obtained and, by analyzing the problem, it can be seen that the number of cents is either three, four, or five more than three times the number of dollars, depending on whether the number of cents is below 34, below 67, or above 66. The answer must be a whole number, which is obtained only by using four, and the check was for $11.37.—E.A.B., Savannah, Ga.

He Turns the Heat on Reader's Freezing-Point Error

IT SEEMS that D.O., of Berkeley, Calif., is a little too anxious to find fault with your magazine. When he says that the freezing point of water is very insensitive to pressure, he does this useful fluid a grave injustice. The freezing point of water is just as sensitive to pressure as is its boiling point. As Charles E. Dull says in his book on modern physics, "a substance that expands upon freezing has its melting point lowered by an increase in pressure." Another thing, the water in this hypothetical lake will not be four degrees centigrade, but *(Continued on page 16)*

On His Record—
Which Man Would YOU Hire?

You Are Hired on YOUR Record—
Employers Want to Know, Are YOU Prepared for Promotion

Your own ability to hold the better jobs depends entirely on the preparation you have made to accept the **opportunities offered every month in the year** in the active fields of today such as Air Conditioning, Diesel Engineering, Drafting and Design, etc. Men in these fields and others with preparation as accountants and in merchandising are being advanced into such openings as department heads, managers, foremen, superintendents, travelling auditors, etc.

Your opportunity today simply means being **ready** for the good jobs looking for good men—your chance for a worthwhile position depends on whether or not you will prepare to meet the demands of employers all over the country who are offering the big jobs to men who can handle them!

Without training a man is no more valuable at 40 than at 30, is old at 50. But the doctor at 40 or 50 is a better doctor than he was at 30—and it's the same with men trained in other fields—executives, draftsmen, engineers, merchants, architects **are young at 40, at 50**—and still have many good pay years ahead. Promotion, increased pay, reward properly prepared men!

American School, an educational institution incorporated "not for profit," has used for over 40 years a direct and practical method for preparing men to handle the **bigger jobs in business and industry.**

American School graduates hold important positions as engineers, accountants, experts, draftsmen, managers, etc., or successfully operate their own business. Thousands of our High School graduates have entered colleges, universities, normal schools, etc., have attained success in business or industry.

Find out how American School can help YOU, the difference it may make in your entire future **success** and **happiness!** Mail coupon today for **free** Bulletin and early lesson in field of your choice. No obligation on your part.

American School, Dept. G-446, Drexel Ave. at 58th St., Chicago

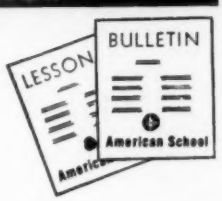
Cut Along This Line

Try a Lesson Yourself—No Obligation

American School, Dept. G-446, Drexel Ave. at 58th St., Chicago

I have checked the line of work in which I would like a good job. Please send me without expense or obligation on my part a copy of your Bulletin and an early lesson in the field I have selected.

- ☐ Air Conditioning
- ☐ Architecture
- ☐ Automotive Engineering
- ☐ Automobile Repairing
- ☐ Bookkeeping and Cost Accounting
- ☐ Business Management
- ☐ Civil Engineering
- ☐ Aviation
- ☐ Contracting, Building
- ☐ Electrical Engineering
- ☐ Diesel Engineering
- ☐ Drafting and Designing
- ☐ Electric Refrigeration
- ☐ Heating, Ventilating, Plumbing
- ☐ Professional Accounting Incl. C. P. A. Coaching
- ☐ High School
- ☐ Highway Engineering
- ☐ Law
- ☐ Liberal Arts (College)
- ☐ Mechanical Engineering
- ☐ Merchandising
- ☐ Private Secretary
- ☐ Radio and Television
- ☐ Salesmanship
- ☐ Shop Practice
- ☐ Shop Management
- ☐ Steam Engineering



Name ..... Age ..... Occupation .....

Street ..... City ..... State .....

Our Readers Say (CONTINUED)

zero degrees, because our physics books tell us that ice and water, in contact with one another, will have a temperature of zero degrees centigrade.—D.C., San Jose, Calif.

Oysters R Safe To Open—Even for the Uninitiated

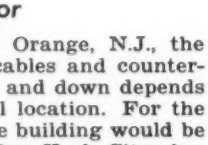
UNDER heading of "With the Inventors," I noticed the oyster-opening device designed by Joseph E. Benson, of Cedar Rapids, Iowa. It particularly struck my eye because I live on the Gulf of Mexico, and frequently see oysters handled. I know that a man who has had any experience opening oysters is in no danger of cutting himself, and, even if he had had no experience, ten-cent gloves would save his hands.—D.B.G., Pensacola, Fla.

Think of All This When You Get On Another Elevator

IN REPLY to P.O.C., East Orange, N.J., the lateral thrust in elevator cables and counterweights as the car goes up and down depends mostly on the geographical location. For the maximum belling effect, the building would be at the equator. But in a New York City skyscraper, there would be a combination of forces that would tend to produce an angled lateral thrust. The belling of the cables would be a constant convex arc depending on length, load, and the resultant effect of centrifugal forces. The arc would be influenced further by the equinoctial procession.—E.P., U.S.S. *Maury*, Mare Island, Calif.

He's Glad To Learn What the College "Youngsters" Are Doing

IT pleases me very much to see that your magazine takes such an interest in what the mechanically minded students of American colleges are doing. Your story of Frank S. Wyle and his amazing stop-action pictures proves that your magazine takes an interest in them. I hope that more stories describing the engineering feats and projects of these youngsters will follow, feeling that a lot of your readers, including yours truly, will enjoy reading about the projects and feats of our future engineers. —J.T.C., Buffalo, N.Y.



The Item on Page 89 Throws Some Light on This

THE letter from A.D.F., who wondered whether people have a "sixth sense" of time, interested me very much because I, too, found myself waking up repeatedly just before my alarm clock was set to go off. It seemed almost uncanny, so one night I decided on an experiment. The following day was a holiday, and I could risk sleeping over. You guessed it, I didn't set my clock. And I overslept, missing a golf date. Then I got more scientific and experimental. I set the thing to go off in twenty minutes, and picked up the latest issue of P.S.M. so that I'd be sure *not* to fall asleep. In exactly fifteen minutes, the alarm mechanism gave a soft click that seemed to come from nowhere. Five minutes later, the alarm did its duty on schedule. Now I'm convinced that it was the click that had been waking me up.—V.S.P., Oneida, N.Y.

It Hustles the Work and the Workers, Too

THE trick lumber conveyor shown on page 110 of your March issue probably looks like "a roundabout way to get across the street" to some people. Well, I've worked in lumber yards and I know that a conveyor of this type will do a lot more than just lift the planks. Lumber stackers, like most humans, don't work any faster than they have to, but with a machine passing out boards at a regular pace, they have to hustle or else be buried under an avalanche of assorted wood.—L.M.C., Seattle, Wash.

And It Should Save Wear and Tear on the Brake Drums, Too

SOME of the huge electric locomotives used on mountain runs retard speed going down hill by putting the power from their momentum back into the third rail by means of an electric generator. What I'm wondering is why can't automobile manufacturers make brakes that would similarly conserve, instead of tossing away, a car's braking energy, putting it into a storage battery, for example. The resultant saving in gasoline would be considerable, I should think.—T.D.S., Denver, Colo.

ADVERTISING PAGES REMOVED

How Big Is YOUR PAY-CHECK?

If you earn under $3,000, Higher Accountancy *may be the answer for you*

"THE size of my pay-check? What business is it of yours?" Perhaps that's the first reply that comes to your mind.

But—stop a moment. It really *is* our business—to help men just like you. In fact, it's been our business here at LaSalle for 30 years.

If your pay-check isn't all that you'd like it to be, why not consider accountancy? Why not become a member of this well-paid and respected field? Why not, in short, prepare yourself to earn real money—insure a good home for your family—a new car—an education for the growing youngsters—a bank account for a rainy day . . . these and many more of the precious things in life?

Maybe you're one of those ever hoping for "breaks" that will give you a higher standard of living. Yet that's precisely what most of 30,000,000 other employees in this country are doing.

Not all of them, of course. Here and there you find ambitious men who aren't depending on luck to carry them ahead. They're following a tested path to increased earnings—leaving nothing to mere chance. They're *training* themselves for better jobs—every week spending a few hours in serious but interesting study at home.

Some day, as expert bookkeepers and later as accountants, these determined men will have standing and a considerably larger income—in a profession that pays and pays well.

Why don't *you* do as they are doing—take advantage of LaSalle training? Even though you do not know the fundamentals of bookkeeping now—you nevertheless may have an excellent opportunity to master accountancy. Many others have done it.

Perhaps you're asking yourself, "But don't these others possess natural ability that I lack? Don't I need a special talent for all this?"

Ask rather, "If I do my part, won't *I* get results, too?"

You will! For all it takes is intelligence, serious study and work—not genius. Under the LaSalle system you solve problems by simple steps . . . from day to day, as an expert accountant does. You use the same basic principles. And when these problems become difficult and puzzle you, you get counsel that could be matched only through personal coaching by a battery of experts in a big accounting house.

In a comparatively short time, you train yourself in Elements of Accounting, Principles of Accounting, Auditing, Cost Accounting, Business Law, Organization, Management and Finance. The training—complete and intensive all the way—takes you right into C.P.A. coaching if you desire.

Later, when you're an accountant, it may be possible to go into business for yourself as a public accountant and be independent. Or, if you choose to work for someone else as an executive accountant, it well may be for a salary several times that which you draw now.

Write for this FREE book

If you're tired of pinching pennies, investigate accountancy and LaSalle training. There isn't a faster, less expensive or more convenient method to master accountancy. Fill in the coupon and mail. We'll send you our 64-page book, "Accountancy, The Profession That Pays."

Then, when you read all the facts, you yourself will be able to judge best whether you have the will to study and apply your best efforts—toward a more secure future.

LaSalle Extension University

A Correspondence Institution

Dept. 483-HR **Chicago, Ill.**

I want to earn a bigger salary—through accountancy training. Send me, without cost or obligation, your 64-page book, "Accountancy, The Profession That Pays."

Name.....

Present Position..... Age.....

Address..... City.....

With the Inventors

ANIMAL TRAPS that kill rats, mice, and other rodents, knock them out of the way, and then automatically reset themselves for the next victims, are the novel invention of Samuel J. Evans, of Princeton, W.Va. The boxlike design of the device incorporates an open end in which bait is attached to a trigger. When a rat noses into this hole and tugs at the bait, the trigger releases a catch causing a spring-operated arm to snap around at high speed. The jagged, sawtooth end of this arm hits the rat, killing it and hurling it away from the trap by the force of the blow. The arm then completes its circular swing until stopped by the catch in position for the next rodent that nudges the bait. The spring mechanism is wound like a clock to operate the killing arm a number of times between windings . . . ONLY ABOUT FOUR PATENTS out of every hundred include more than twenty claims—statements of what the inventor regards as new and invented by him . . . ELECTRIC LIGHTER, cigarette compartment, and ash tray are conveniently placed in the hub of an automobile steering wheel devised by Edward G. Von Gunten, of Akron, Ohio . . . IF YOU HAVE SPENT A LIFETIME trying to hide the fact that your fond parents tagged you with the name of Ebenezer, and have signed your letters "E. H. Smith," and encouraged your friends, and even your wife, to call you "Butch," don't become an inventor, for there will be no way to escape taking down your hair and telling all. Inventors applying for U.S. patents must give their full names. Initials don't go . . . DESIGNED FOR RADIOS having two or more frequency bands, a new tuning dial has a pointer whose tip always indicates the band in use, instead of constantly overlapping all the bands marked on the dial, as is the case with most systems at present. The dial arm automatically becomes longer or shorter at its pointer end, so that its tip touches the edge of the particular dial strip marked for the frequency band being used. This idea was worked out by a German inventor, Raymond Buchardt, of Berlin . . . TOP HONORS for the tongue twister of the month among patent titles: "Butyl Esters of Alpha-Alpha-Dimethyl-Alpha[1]-Carboxydihydro-Gamma-Pyrone" . . . RAINY-DAY SHOPPERS who have both arms full of packages and bundles are one group who should welcome an umbrella hat credited to Lloyd D. Myers, of Minneapolis, Minn. The accessory is essentially a diminutive umbrella with the supporting ribs attached to a skullcap that is worn on the head and held firmly in place by straps under the chin . . . MARKING THE WORD "PATENTED" on an unpatented article is a violation of the law. Mark 1,000 unpatented items with the word and you would be liable to a fine of $100,000—$100 for each offense . . . A NEW CONVENIENCE FOR MOTORISTS, to add to drive-in stores, curbside

(Continued on page 24)

TRAIN FOR ELECTRICITY

Pay Tuition AFTER GRADUATION

12 WEEKS Actual Shop Work In My Big Chicago Shops

WANT TO EARN MORE MONEY?

Have **you** ever dreamed of holding down **a steady, good pay job?** Have you ever dreamed of doing the work you really like in a job that holds promise of a **real future** in the years ahead?

Well, we all know that you can't get the good things in life by just **dreaming** about them. Hundreds of fellows **are** today holding down mighty fine jobs with prospects of a bright future. They are filling these jobs because they **had** the foresight to equip themselves with the **right kind of training.** Most of these men were only average fellows a short time ago, but the proper training helped to lift them out of the low pay ranks of unskilled workers. The same opportunity is now offered to **you.**

The great fascinating field of **ELECTRICITY** offers a real future to many men and young men who are willing to prepare for a place in this giant industry.

AN EXTRA 4 WEEKS COURSE IN RADIO INCLUDED

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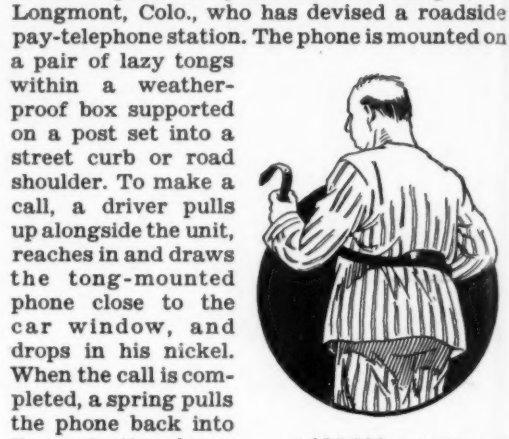
With the Inventors

(Continued from page 22)

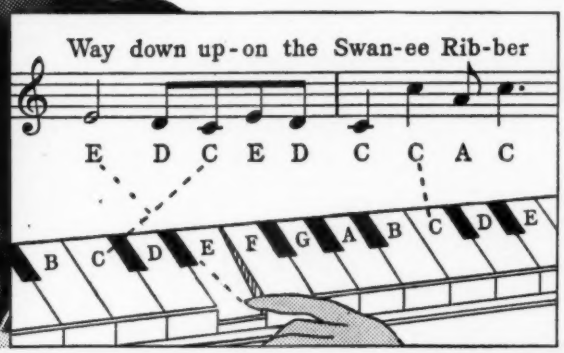
banks, and open-air automobile movie theaters, is planned by Edmund H. Yaeger, of Longmont, Colo., who has devised a roadside pay-telephone station. The phone is mounted on a pair of lazy tongs within a weatherproof box supported on a post set into a street curb or road shoulder. To make a call, a driver pulls up alongside the unit, reaches in and draws the tong-mounted phone close to the car window, and drops in his nickel. When the call is completed, a spring pulls the phone back into its protecting box . . . 1,000,000 COPIES OF PATENTS are shipped out of the United States each year, in exchange for copies of patents issued by foreign countries . . . IF FRIEND WIFE strenuously objects to that groaning and wheezing rumble commonly termed snoring, and you are one of those who snore only when sleeping on your back, you might look into a recent invention designed to curb this type of "thunder." This is a belt which is strapped around the waist just before turning in. A hump at the back of the belt is guaranteed to prevent the wearer getting even forty winks if he lies on his back. The field is still wide open, however, for the invention of devices to silence side and stomach-sleeping snorers . . . THE NAMES OF ABOUT 10,000 patent attorneys appear on the roster of the United States Patent Office . . . RADIO SETS are shut off automatically when a person

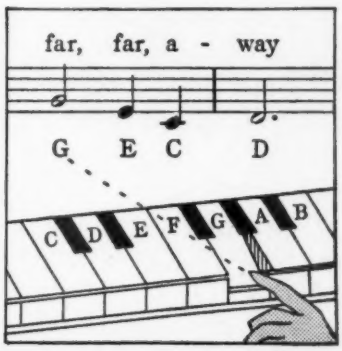


picks up a hand-type telephone fitted with a special electric switch, in a system devised by Clarence J. Sloan, of East Cleveland, Ohio. Gravity-operated, the switch is attached near the transmitter end of the phone and wired to the radio in such a way that it cuts the power supply of the set to silence it whenever the switch is tilted as a person raises the telephone to make or answer a call . . . TRADE

(Continued on page 26)

YOU CAN PLAY THE MELODY OF "SWANEE RIVER" RIGHT NOW—*HERE'S HOW*





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I want to say that my friends are greatly surprised at the different pieces I can already play. I am very happy to have chosen your method of learning.
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I didn't dream I could actually learn to play without a teacher. Now when I play for people they hardly believe that I learned to play so well in so short a time.
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● Look at the diagram above. The first note is "E." That's the white key to the right of the two black keys near the middle of the piano keyboard. The next note "D," one note lower, is the next white key to the left and, similarly, the next note, "C," is the next white key to the left of that one. The following three notes are simply a repetition of the first three and there you are, actually playing the familiar melody of "Swanee River."

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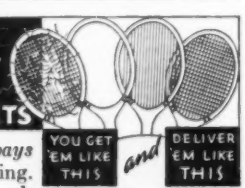

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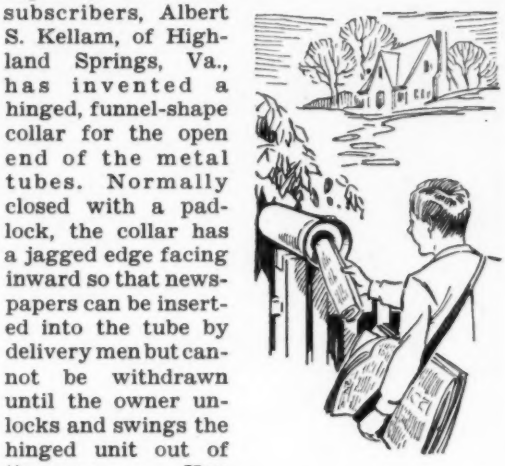
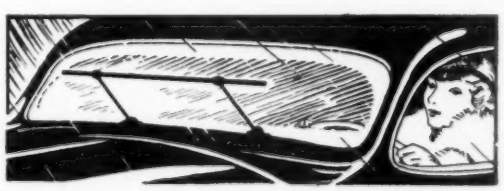
With the Inventors

(Continued from page 24)

MARKS can be registered in individual states as well as in the Patent Office in Washington . . . TO PREVENT THE PILFERING of newspapers from the roadside tubes in which they are deposited for rural subscribers, Albert S. Kellam, of Highland Springs, Va., has invented a hinged, funnel-shape collar for the open end of the metal tubes. Normally closed with a padlock, the collar has a jagged edge facing inward so that newspapers can be inserted into the tube by delivery men but cannot be withdrawn until the owner unlocks and swings the hinged unit out of the way . . . YOU WOULD NEED A LARGE ENVELOPE and the eagle eye of a professional proof reader to address a letter to the inventors and the assignee of patent 2,142,621, recently issued. It was granted to: "Kenjiro Tsuneda, Higashiyamaku, Kyoto, and Yasusaburo Hironaka, Tsuwano-cho, Kanoashi-gun, Shimane, Japan; said Hironaka assignor to Takara Jidosha Kogyo Kabushiki-Kaisha, Tokyo, Japan" . . . INSTEAD OF WIPING only one pie-shape section, a new automobile-windshield cleaner clears





practically the entire area of the glass. A long, horizontal wiping blade is supported on two motor-driven vertical arms that swing in arcs like the wiper blades of present windshield units. This arm motion causes the horizontal wiper to follow a curved path that extends from one side edge of the windshield clear across to the other . . . WHERE SHADING IS INDICATED in patent drawings, regulations state that the light must be assumed to come from the upper left-hand corner of the page on which such drawings appear, at an angle of forty-five degrees.

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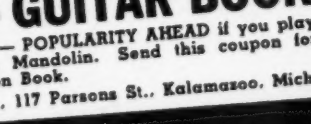

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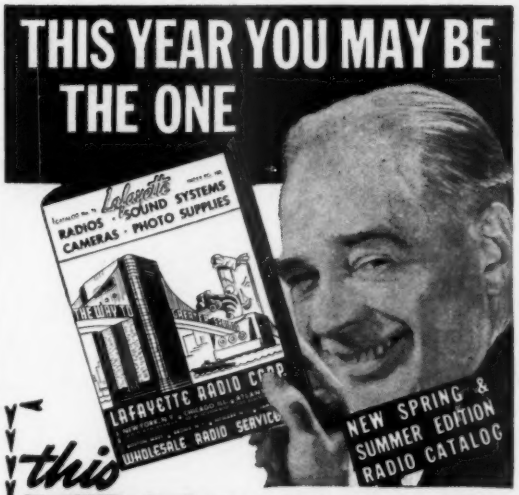

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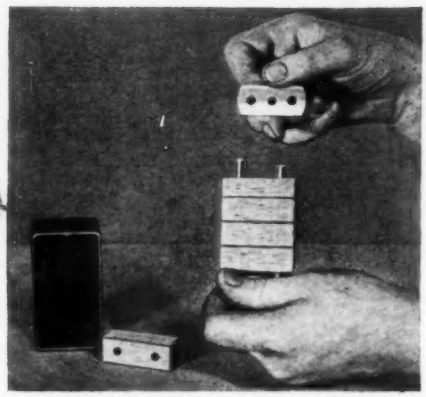
FOR HOME OWNERS

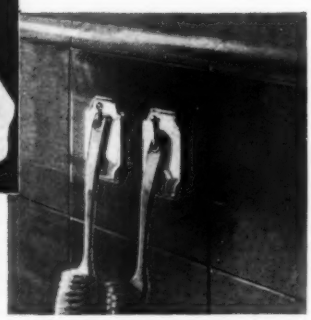
Easy to hold, the scraper is handy for use on floors



To assemble the paint scraper, razor blades are sandwiched between oblong cork blocks

Many-Edged Floor Scraper Uses Old Razor Blades

RAZOR BLADES and cork blocks are combined to form a useful many-edged scraping tool now available. Held in place by two cross rods, blocks of cork and thin safety-razor blades are stacked alternately as shown in the photograph above. Pressure is applied to compress the cork separating the blades, and the assembly is then incased in a metal holder to protect the user's hands when scraping floors, removing paint from furniture, or performing other household repair work.



Special cement furnished with these wall hooks secures them firmly to a tile, glass, metal, or plaster wall without nails

Accessory Hooks Stick to Walls

USED with a special adhesive, handy new hooks for hanging bathroom or kitchen accessories can be firmly attached to glass, tile, plaster, or metal walls without the use of screws or nails. Made like a fountain-pen clip, the hook is fastened to a plastic backing. When the special cement is smoothed on this backing, it will adhere to the wall surface, supporting weights up to five pounds.

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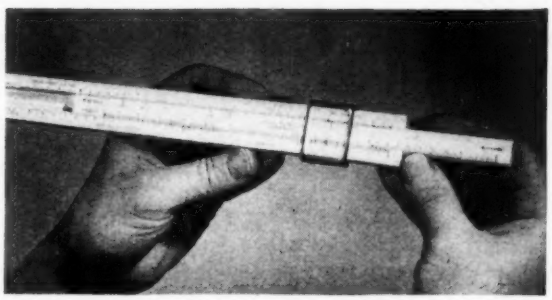

This rule quickly determines brick or tile requirements

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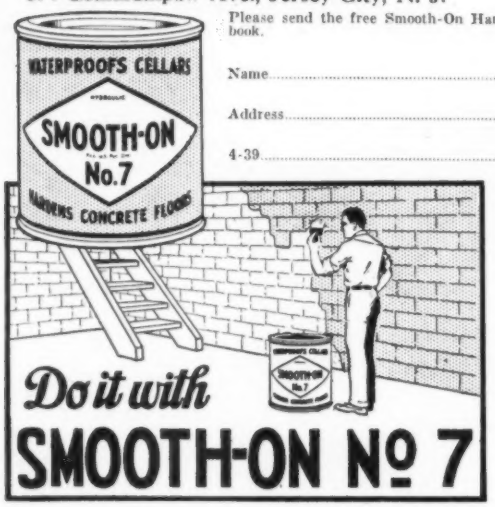

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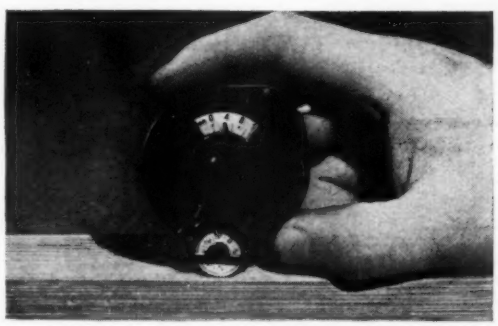
DIMENSIONS of an object or piece of material in feet, inches, and fractions of an inch can be read off the scale of a novel vest-pocket measuring device just introduced. A small wheel projecting from the unit is rolled along the surface to be measured, as pictured below.



The wheel is rolled along the surface to be measured

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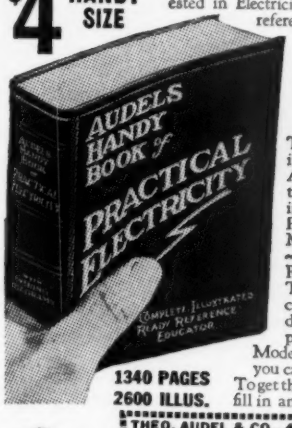

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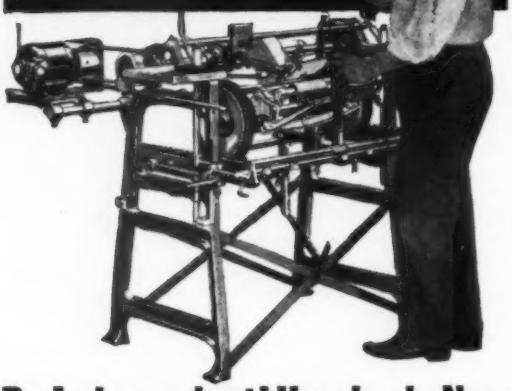

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Questions FROM HOME OWNERS

Q.—Is it possible to use wax on a painted surface in order to make the finish last longer and permit the cleaning of soiled spots without the necessity of repainting?—P.M.C., Chicago, Ill.

A.—Wax will preserve a painted surface, but has the objection of being difficult to remove when repainting is necessary. A better expedient, one frequently used on fine paint jobs, is to apply a starch coat over the painted surface. This is made from regular lump starch rubbed to a thin paste in cold water and brought to a clear solution in boiling water. This coat, when it becomes soiled, is sponged off with warm water, and a new coat applied. Treated in this way, the paint will last indefinitely.

Sawdust for Insulation

W.B., Glenville, W.Va. Although it has a fairly good insulating value when placed in the walls of a house, sawdust has too many objections to make its use practical. It must be fireproofed, treated to prevent decay, made insectproof, and can then be used only when walls are absolutely water-tight. For if the sawdust becomes damp it may swell; it may turn moldy and rot the wood walls next to it; and, finally, it would tend to make the paint on exterior walls blister and scale off. Better stick to some other insulating material that does not involve so much trouble.

Soundproofing a Door

M.E., New York, N.Y. A door may be made soundproof by applying any good sound-insulating material and then covering it with plywood, hard pressed board, or other finishing material. The door must, of course, fit snugly. If it doesn't, the insulating material can perhaps be arranged so that it laps over the frame and forms a rabbet, as in the case of an ice-box door. This will make a sound-tight fit.

Rumbling in Toilet Flush Tank

H.N., Brooklyn, N.Y. A rumbling noise that occurs in a toilet flush tank as it fills with water is probably due to an improperly feeding inlet valve. Sometimes this may be remedied by bending the float rod slightly, but if you want to effect a sure, permanent cure it is better to dismantle the valve and put in a new washer.

ADVERTISING PAGES REMOVED

VOL. 134, NO. 4 POPULAR SCIENCE Monthly APRIL, 1939
RAYMOND J. BROWN, Editor

Captain Kidd's Gold?

Did pirates hide their loot in the tide-guarded money pit of Oak Island?

DRAWINGS BY B. G. SEIELSTAD

Using the Tools of Modern Engineering, Scientific Treasure Hunters Will Attack a Strange, Sea-Guarded Subterranean Vault on a Mysterious Island off Nova Scotia

By EDWIN TEALE

AS SPRING moves up the North Atlantic coast this year, a well-equipped American expedition is preparing for a new attack upon the fabulous "money pit" of Oak Island. Only a mile and a half long, this island nestles close to the eastern shore of Nova Scotia, not far from the resort town of Chester. According to legend, it is the site of a mysterious, flooded stronghold of buried treasure. For nearly a century and a half, men have probed the earth of the island, seeking the elusive gold. More than a quarter of a million dollars has been spent in this

SECOND SHAFT SUNK BY EARLY TREASURE HUNTERS
SUPPOSED SITE OF TUNNEL AIR SHAFT
TIDE LEVEL
TUNNEL, FILLED WITH ROCKS TO PREVENT CAVE-INS, CARRIES SEA WATER TO FLOOD "MONEY PIT"
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CONVERGING DRAINS LEAD THROUGH SPONGELIKE BEACH TO ENTRANCE OF UNDERGROUND TUNNEL
FLOODED "MONEY PIT" HOLDS SECRET OF TREASURE MYSTERY
SAND
COCONUT FIBER
EELGRASS
DRAIN

Odd oak trees give the island its name

How the unknown builders of the mysterious subterranean vault turned a beach into a man-made sponge to keep the treasure pit flooded. The hand above holds a sample of the coconut fiber unearthed from the sand

long search without solving the mystery.

Now, under the direction of a New Jersey engineer, workmen will use high-speed electric pumps, compressed-air drills, and the latest resources of science in an assault upon the cunningly contrived vault where the treasure is supposed to lie. An amazing discovery, within recent months, has provided fresh clews to the strangest riddle in the annals of treasure hunting.

In a high-ceilinged room, where a desk lamp carved out a hollow of yellowish light in the darkness, I recently listened until long past midnight to the man who is leading the latest expedition to the northern island. We had been talking steadily since early afternoon. Maps—pirate charts and the latest products of cartographers—lay scattered across a great, flat-topped desk. From time to time, an arm entered the circle of light to point out a spot or trace a line while the voice of the nearly invisible speaker unfolded its tale of mystery and research.

The story of Oak Island goes back to the year 1795. Its earliest chapters are recorded in that curious old volume: "History of the County of Lunenburg," by Judge Mather Des Brisay. The island, which is approximately half a mile wide, is one of more than 350 dotting the surface of Mahone Bay, forty-five miles down the ocean side of Nova Scotia from Halifax. The name of the bay comes from a French word designating the swift, low-lying pirate craft that used to hide in the island maze.

All except one of these islands are covered

While a farmer was plowing near the beach, the ground gave way beneath his oxen and the animals fell into a deep, hidden pit

with spruce. That one is distinguished by curious oak trees with elmlike tops. The earliest settlers viewed this island with superstitious dread. Those living nearest it on the mainland reported seeing flickering lights and hearing strange cries in the night. For many years, no one dared to go near the spot.

Then, one autumn morning in 1795, three adventurous youths, Anthony Vaughan, Jack Smith, and Daniel McGinnis, paddled out to the island on a hunting expedition. Vaughan was only sixteen; the two others a little older. Descendants of all three still live in the region.

With guns ready, the young explorers pushed their way in among the strange trees, awed by the mysterious, primeval quiet. Fifty yards from shore, they came upon an open space above which towered a gigantic oak with one horizontal limb cut off several feet from the trunk. The top of this stub was deeply scarred, as though by running ropes or cables, and beneath the limb the boys found a circular depression in the sod, roughly a dozen feet in diameter.

The next day, they returned with picks and shovels. Pirate lore of the region centered about Mahone Bay, and they were certain they had stumbled upon buried loot. Ten feet below the surface, they struck a heavy platform of hewn timbers. Below it must lie doubloons and pieces-of-eight! But when the wood was removed, only more earth was found below. At twenty feet, they struck another platform. Their hopes soared again, and again they found only dirt below. The digging became more difficult. All the clay had to be hoisted to the surface in a bucket. When they had descended thirty feet, their picks encountered a third platform of oak. Disappointment lay below; they found clay instead of gold. Winter closed in about this time and digging stopped.

In fact, eight years went by be-

Where the mystery island is located. It is one of about 350 dots of land in Mahone Bay, once famous as a favorite lair of pirates

fore work was resumed. Without investigating, the skeptical mainlanders rejected the boys' story as a hoax and refused their help. Unable to proceed alone, the three bided their time. Two married, settled down on Oak Island, and brought up children within sight of the mystery pit. It was when one of these children was born that a physician from Truro, N. S., a Dr. John Lynds, became interested in the island. He organized the first Oak Island Treasure Company. Together with a group of his friends, including the original discoverers, he began operations in 1803.

Mysteries encountered by the diggers during that short northern summer, 136 years ago, have become more puzzling with the passing of time.

As the workmen descended, they found some marker or platform at every ten feet. Most of the time, these were heavy layers of oak or spruce; once it was a stratum of charcoal; another time, a thick matting of some tropical fiber such as is found on the outside of coconuts. Forty, fifty, sixty, seventy, eighty, ninety feet, the pit continued downward.

When the diggers had reached a depth of ninety-five feet, they quit to return to the mainland over Sunday. Before they left, they drove an iron stake into the ground at the bottom of the pit. When it had penetrated five feet, and reached the 100-foot level, it entered the planking of another of the mysterious subterranean platforms. The following Monday morning, the workers were amazed to find sixty feet of water standing in the pit!

As the diggers had encountered no strata of gravel or sand which would account for the seepage, they were at a loss to explain the presence of the water. They started another shaft, a dozen feet from the first one, and continued it down 110 feet without finding any water. But, as soon as they cut a horizontal tunnel toward the money pit, a flood rushed in and filled the second shaft to the same height as that of the water in the first. Later shafts, sunk by other treasure seekers, have told the same story. Only in the immediate vicinity of the money pit is the endless flow of water found.

Baffled by this mystery, the 1803 company exhausted its funds and ceased operations. Nearly half a century went by before a second treasure company, in 1849, began afresh the search for hidden gold. Dr. Lynds was also active in this venture. By that time, the old diggings were filled with dirt and debris. But Anthony Vaughan, then a feeble old man, pointed with his cane to the spot where first he had seen the depression in the sod, and work began.

At approximately ninety feet, water rushed in and filled the pit as before. Bailing it out proved useless. So the company tried a new approach. At that time, an itinerant coal prospector was going about Nova Scotia boring into the ground with a primitive drilling mechanism run by horse power and known as a "pod auger." He was hired to bring his "pod auger" to Oak Island. Boring down through the mud of the water-filled shaft, the drill struck the platform at 100 feet, bringing up *(Continued on page 232)*

Sea water being pumped from the pit. This year, powerful electric pumps will battle the inrushing tide

Extra Keyboard Saves Pianist's Reach

TWO separate keyboards, one above the other, distinguish the novel piano pictured above. One keyboard sounds tones an octave higher than the other, a special pedal-operated coupling device allowing both to be played together or either one by itself. Instead of being more difficult to master than the standard single-keyboard piano, the new instrument is said by its inventor to be much easier to play, particularly for children who find it hard to reach widely separated chords on the conventional single-keyboard piano.

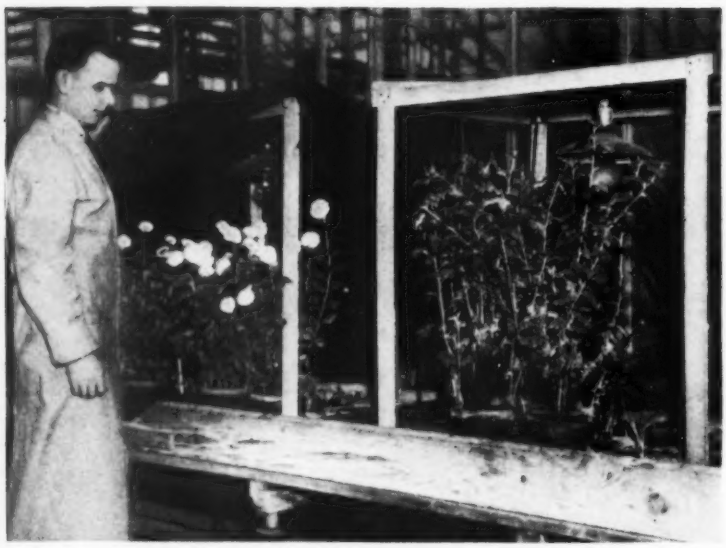
Driving golf balls along a small alley, the player tries to knock down pins

Golf Game Is Right Up Bowler's Alley

FEATURES of both bowling and golf are combined in a novel indoor game recently introduced in Boston, Mass. Using a regulation golf club, a player hits a golf ball down a small-size bowling alley in an attempt to knock over diminutive pins. Three shots are allowed at each set-up of the pins. In the photograph at the left, a feminine enthusiast is shown about to send her second shot down the alley in an effort to hit the pins.

Knife Blade Is Reversible

A PENKNIFE with a bottle opener on one end of its single blade is pivoted in a frame so that either the blade or the opener can be swung out, while a hinged guard holds the tool firmly when it is being used, as illustrated at the right.

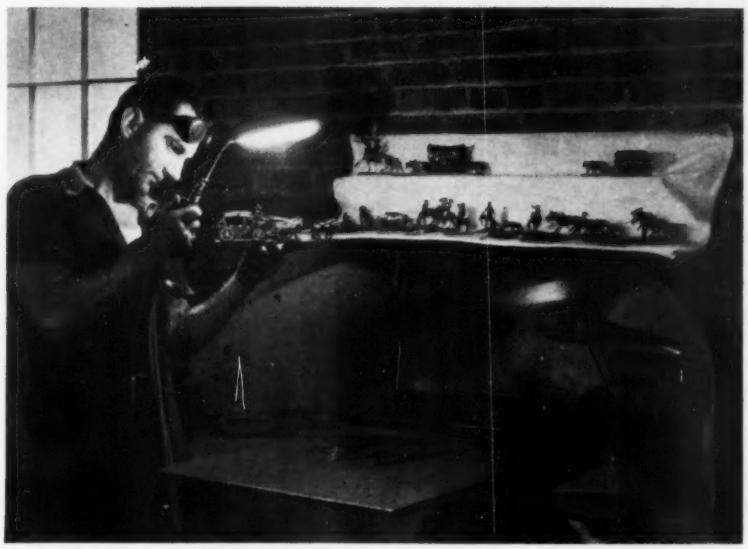


These plants are made to bloom at any desired time by controlling light

Light Control Makes Plants Bloom Any Time

BASED on the known relation between the blooming period of plants and the length of day at the time of blooming, experiments conducted by Karl C. Hamner, University of Chicago botanist, have demonstrated the existence of a plant hormone, a chemical substance within plants, that may be controlled to force flowers, fruits, or vegetables to produce out of season. Artificial light is used to speed up the plants' growth.

Welder Makes Tiny Metal Statues



F. F. Nichols working at his hobby of forming wild-west figures of metal

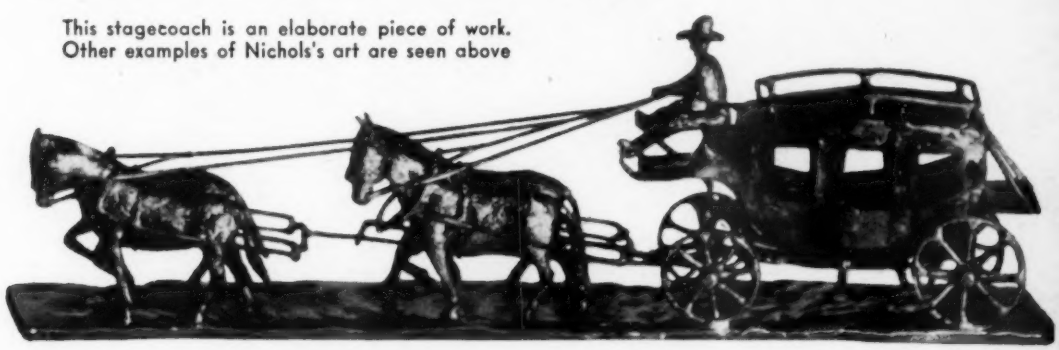
WITH the same oxyacetylene blowpipe that he uses in his daily work to repair castings of massive proportions, F. F. Nichols, skilled welder of David City, Nebr., fashions delicate metal statuettes during his spare time. Tiny figures of his creation, depicting action scenes of the old West, testify to the remarkable artistic possibilities of this odd craft.

For materials, Nichols employs steel and bronze welding rods and a few additional light sheets of steel. In making a mounted group, he shapes the horsemen, saddles, and horses separately, and then welds them together.

To produce one of the individual figures, the welder-artist first melts a steel welding rod. By skillful manipulation of the blowpipe's 6,000-degree flame, he builds up the metal to exactly the desired form. Then, with another welding rod, he applies a lustrous coating of bronze to his work of art. Different effects of shading in the patina, or surface coating of the bronze, are obtained by varying the flame.

During the summer, Nichols has little opportunity to indulge his taste for craftsmanship, but he makes up for lost time in the winter months. For his subjects, he draws upon such rapidly vanishing scenes and memories of the West as cattle branding, bronco busting, prairie schooners, and stagecoaches. Some of his creations are shown on this page. Art experts who have viewed his work find it hard to believe that the pieces come from the same hands that yearly repair and fabricate tons of heavy industrial equipment.

This stagecoach is an elaborate piece of work. Other examples of Nichols's art are seen above



While Mother lays in a stock of groceries, Baby goes along in the double-deck carriage

Shopper's Cart Holds Baby

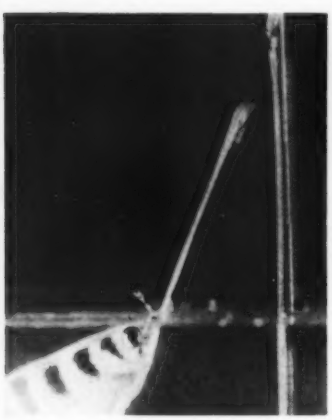
TWIN baskets on a new double-deck wheeled carrier for use in self-service grocery stores provide customers with ample space for carting a large stock of purchases, or, as shown at the left, allow them to wheel children around the store with them as they shop. The four-wheel carrier folds into a small space for easy storage.

Angler's Net Weighs Catch

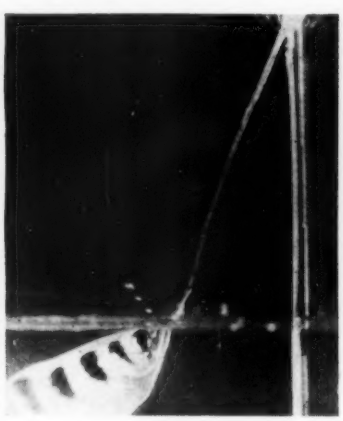
ANGLERS can land fish and weigh them at the same time with a novel landing net that has a weighing scale built into the handle. Compensated for the weight of the net and the handle, the scale gives the exact weight of the fish as soon as it is lifted from the water. A release catch allowing the scale to function is placed at one end of the net handle. Details of the device are shown in the illustrations at the right.

Camera Catches Shooting Fish in Act

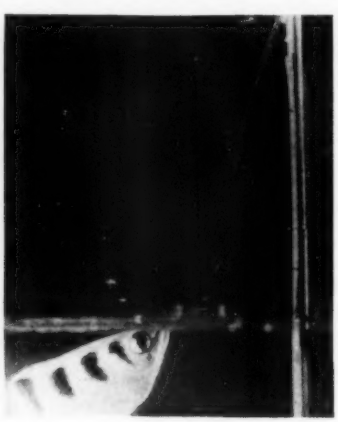
SNAPPED by a high-speed camera, an archer fish, native to East Indian waters, is shown catching an insect in the amazing photographs below. With astounding accuracy, the curious fish blows a stream of water at an insect above the surface, causing it to drop into the water, where it is instantly gobbled by the finny sharpshooter.



Toxotes jaculator, the archer fish, lets fly at an insect on a plant



A bullseye! The surprised victim is struck by the squirted stream



. . . and falls on the surface of the water to be swallowed quickly

Neon Signs Identify Police Patrol Cars

Even in a heavy fog, the neon sign on this police car is plainly visible

POLICE cars assigned to the park districts of Chicago, Ill., are now fitted with roof-top neon signs so that motorists may identify them on the road at any time during the day or night. Within park areas, the police automobiles travel at legal speeds so that drivers may spot them and judge their own speed accordingly. Even in heavy fog, the roof-top signs are easily visible, as shown in the photograph reproduced at the left.

Odd Tricycle Uses Dual Drive

STANDING on pedals, the rider of a curious new three-wheeled vehicle shifts his weight from one foot to the other to drive it forward, supplementing this source of power by turning a hand crank geared to the front drive wheel. Power from the pedals is transmitted to the wheel by means of a ratchet arrangement.

A. P. Steele with the working model of his three-wheeled "bike." Foot pedals and a hand crank drive the front wheel

Bottle Opener Catches the Fizz

A NOVEL bottle opener has a rubber shield which fits around the neck of a bottle as it is being opened, to prevent the contents from spurting out suddenly. The opener allows excess gas in charged water or carbonated beverages to escape before the cap is completely removed.

New Color-Printing Process

PRODUCES REMARKABLE COPIES OF FINE ART

A pressman testing the gelatin-coated printing plate used in the new process

By KENNETH M. SWEZEY

REPRODUCTIONS of noted works of art, so faithful that they can hardly be distinguished from the originals, are now made possible by means of a remarkable printing process just perfected after fourteen years of research. As a result, the cost of fine reproductions has been brought within the reach of every home.

The secret of Gelatone printing, as the new process is called, lies chiefly in the use of a half-tone screen, the pattern of dots which forms the printed image, so fine that individual dots can be seen only with a powerful magnifier. With ordinary printing methods, the practical limit for a screen is about 22,500 dots to the square inch. With Gelatone, it is possible to use a screen of 160,000 dots to the square inch!

Such fine screens have long been available; but how a process could be perfected that could consistently print from plates made with such screens—on rough papers as well as glossy, and without clogging the microscopic spaces between the dots—was a problem that has taken years of experiment to solve.

In theory, it was beautifully simple. A plate of zinc was coated with a sensitized gelatin film, and a properly screened negative containing the matter to be printed was photographically printed on it. The plate was then washed with water. This caused the parts that had been exposed to the light to become oxidized and repellent to water, while the parts that had not been exposed remained absorbent to water.

When such a plate was moistened with water, and ink applied to it, the ink would attach itself to every printed part of the image, while the unprinted portions would repel the ink. The result was a printing plate that had all the good characteristics of a lithographic stone, with the added advantages of cheapness and the possibility of working photographically with a fine screen.

To print such a plate on rough paper could be easily accomplished with an "offset" printing press. In such a press, the paper never comes directly in contact with the printing plate. Instead, the impression from the inked plate is transferred to a cylinder covered with a rubber "blanket." This blanket is then rolled over the paper, the flexibility of the rubber permitting the ink to be impressed onto every part of the irregular surface.

In practice, however, the process had the drawback that it wouldn't work with existing techniques and equipment. Stiffer and tackier inks had to be developed; Monel metal had to be substituted for zinc, to give longer-wearing

Sensitizing solution being poured on plate. The whirling machine spreads and dries it

"SUNLIT PATTERNS," a water-color painting by Luigi Lucioni, as reproduced from the original by the recently perfected Gelatone process

plates; the adjustment of the offset press had to be modified to permit more accurate control of ink and moisture; special surfaces of paper had to be evolved to bring out the greatest beauty of the printing; even a special air-conditioning plant had to be installed to prevent erratic shrinking and swelling of the gelatin.

Just a few weeks ago, announcement was made that the Gelatone process had finally been perfected. According to the technicians, however, research will continue to go on. The excellent works now being reproduced are all copies of paintings and drawings done in water color and other mediums without luster. Simulation of glossy oil paintings, on paper to duplicate the texture of canvas, will probably be the next goal. Meanwhile, the Associated American Artists are exhibiting Gelatone facsimiles of the work of twelve American artists in 100 cities of the United States.

"WOMAN WITH PLANTS," from the oil painting by Grant Wood. Reproductions like this are now within the reach of every one

Charles Miller (left) and S. M. Barber inflating balloons for use in the novel sport of aerial fishing near Long Island, New York

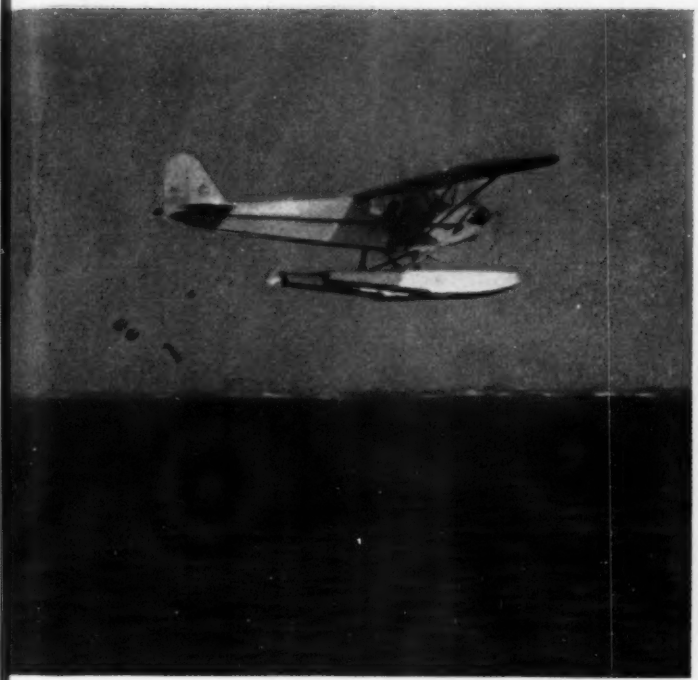
Here Miller is attaching set lines to a cork float. Each float has three or four lines, and a colored balloon is tied on as a marker

Flying Angler FISHES WITH BALLOONS

WHEN Charles Miller, New York City airline official, goes fishing, it's no ordinary excursion. In a light seaplane, he combines his favorite sports—flying and angling—by fishing from an airplane.

For this novel pastime, a score of gayly colored balloons form an important part of the fishing paraphernalia. In cork floats, to which the balloon "buoys" will be attached as markers, Miller drills three or four holes and attaches fishing lines. When the hooks are baited and a balloon has been attached to each float, the equipment is stowed away in the plane and the aerial angler is ready for a day's jaunt.

Soaring into the air, he wings his way over the waters that skirt the eastern end of Long Island, New York. From his point of vantage, it is easy to spot schools of fish running near the surface. At



Soaring above the water, as at the left, the flying angler spots schools of fish and drops the floats at likely places

●

After waiting awhile, he returns and easily sights his floats from the air. Below, several of them are to be seen

likely-looking places, he tosses overboard a float that flutters to the water with its baited lines and balloon. The lines sink in the water, while the balloon remains bobbing on the surface like a buoy.

Exploring the shoreline at express-train speed, the airman can cover many times the territory that ordinary anglers could reach in their search for good fishing grounds. When all his balloon floats have been disposed of, he brings down his plane and "parks" for a few hours to await results.

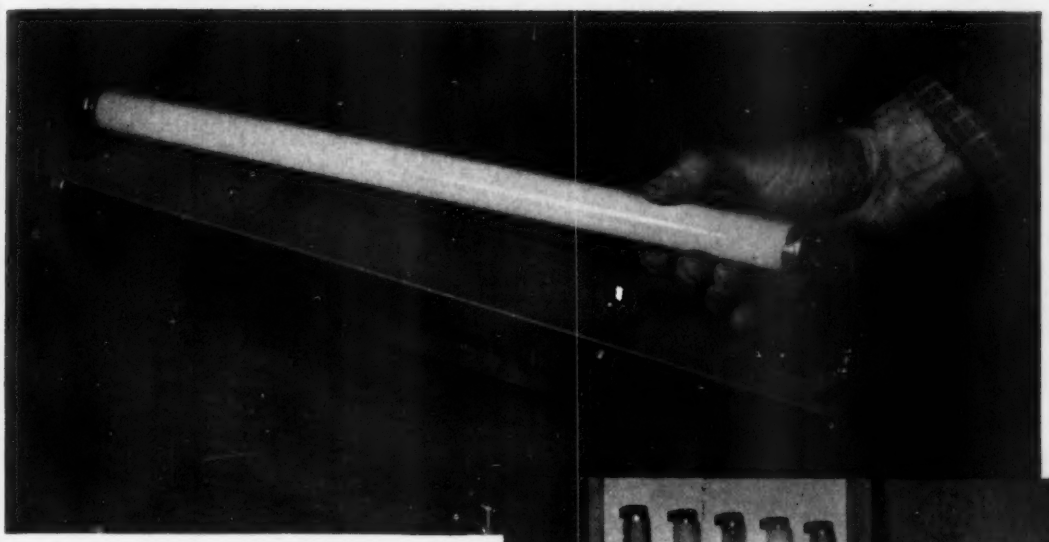
Taking off once more, the sportsman returns to the floats. Even at a considerable distance, the colored balloons are plainly sighted. The plane swoops down, alights on the water near-by, and taxies alongside. Eagerly he hauls the float aboard. Perhaps the catch has been good; perhaps the hooks are bare. But if one try has proved a failure, there may be a couple of beauties on the next float. Flying or taxiing on the water, the plane makes the rounds from one balloon to the next, until all of the equipment and the catch is aboard. Then, with thoughts of a sizzling frying pan, the flying fisherman soars homeward. On some of his expeditions he is accompanied by S. M. Barber, his friend and partner in the ownership of the plane.

Landing near one of the floats, the plane taxies alongside. Oh, boy! A couple of beauties! When all the floats are picked up, the angler flies home

Cold Light OPENS NEW FIELD IN ELECTRIC SIGNS

MAGIC wands of "cold" light, rivaling the rainbow in their hues and the firefly in their efficiency, have come out of the laboratory to paint night scenes with new marvels of beauty. Perfected and ready for use after years of experiment by General Electric research engineers, these "fluorescent lamps," as they are called, apply a brand-new principle in illumination. By doing so, they reduce the cost of colored-light displays to a point where lighting effects hitherto possible only in theaters can be applied lavishly everywhere.

Visitors to California's International Exposition are viewing the spectacular debut of the new departure in lighting. Coated with a micalike material, the iridescent walls of the fair buildings sparkle each night with the pastel hues of floodlights containing 2,300 of the new lamps. The surpassing beauty of their illumination will be seen, too, at the New York World's Fair.



How the new fluorescent lamp is inserted in its sockets. Under the metal base is the unit containing the starting switch. The display panel in the color photograph at right shows the bright hues obtainable

Much as an artist mixes paint, lighting specialists can combine these tubes of glowing color, in an endless variety of patterns and hues. They open a new field in electric signs, from the most modest in size to the monster "spectaculars" of districts like New York's Great White Way. Employed for decorative colored lighting of every description, the rainbow lamps will find striking uses in homes, stores, offices, hotels, theaters, and railway cars.

The secret of the new fluorescent lamp, a glass tube eighteen inches to a yard long, lies in a snow-white inner coating of powdered chemicals. When the current is turned on, these chemicals glow or "fluoresce," like luminous paints used in theatrical effects, under the bombardment of ultra-violet rays produced by a trace of mercury vapor in the tube. So efficiently does this scheme work that the fluorescent lamps emit from fifty to 200 times as much light as incandescent bulbs of similar colors. The amount of current that they waste in the form of heat is negligible, compared with ordinary lamp bulbs and neon-type signs.

At present, the tubes are available in five colors—green, blue, pink, gold, and red. All except the last two, which employ tinted glass, appear colorless until lighted. Their hues depend upon the particular chemicals used in the coating

for the insides of the tubes. "White" and "daylight" tubes also are obtainable, the first matching the warm shade of ordinary artificial light. The "daylight" shade, obtained by a skillful blend of powders, is declared to be man's closest approach to natural light. It finds widespread use in displaying colored fabrics, making colored drawings, and inspecting factory products.

Except for sockets of corresponding design, and a compact switch with a built-in coil for controlling the current, no special equipment or wiring is needed for the fluorescent lamps. Consuming from fifteen to thirty watts apiece, they operate either on house current or from commercial power lines of higher voltage. With proper handling, they are said to have a longer life than incandescent bulbs.

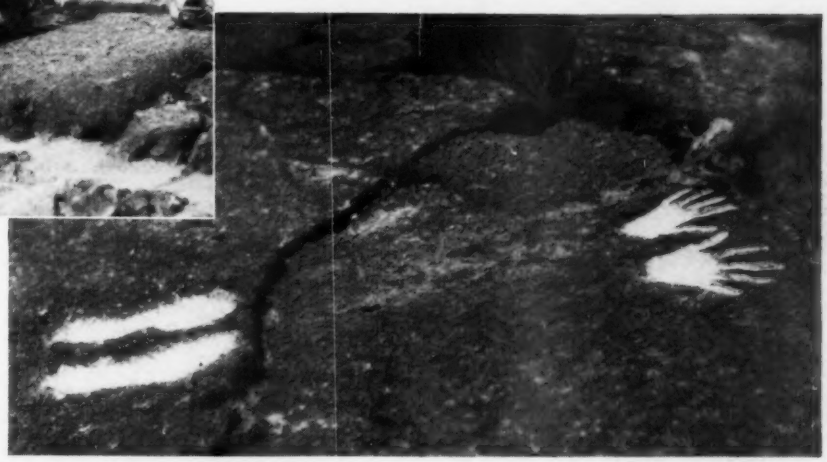
Chemists share with electrical experts the credit for bringing the fluorescent lamp from its first experimental form (P.S.M., June '36, p. 41) to its present practical one. Rare ores originally were the only available source of the required "phosphors" or luminous chemicals, and one batch might glow while others mysteriously failed. Then the experimenters found that many fluorescent minerals, such as zinc sulphide, calcium tungstate, and the silicates of zinc and cadmium, needed traces of certain metallic impurities to make them work. Applying this discovery, and using electric furnaces that subject the ingredients to terrific heat, skilled chemists now manufacture synthetic phosphors that excel nature's best ones for use in the new lamps.

This office is lighted by a ceiling fixture equipped with "daylight" fluorescent lamps. At the left, a worker is mixing synthetic chemical preparations for coating insides of tubes

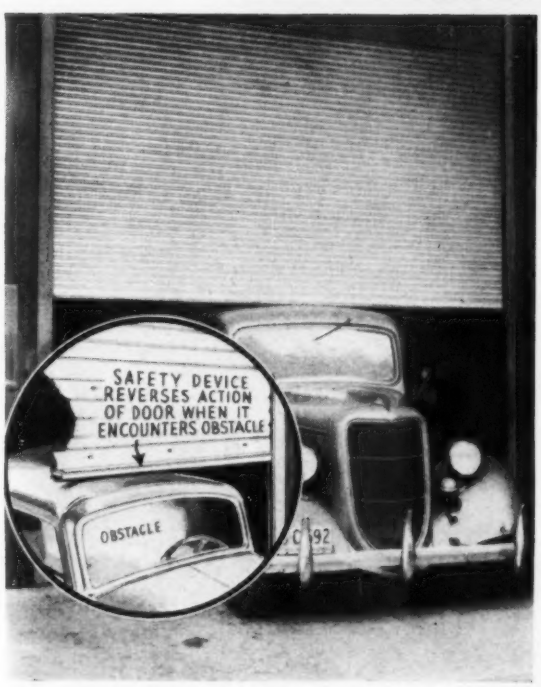
Strange Prints in Lava Hint Indian Mystery

MYSTERIOUS prints of two bare hands and two moccasined feet, sharply etched into lava rock in the Columbia National Forest in the State of Washington, are puzzling students of Indian lore. Local legend says that they are the prints of an ancient princess who jumped from a mountain peak and landed on the spot when molten lava was oozing from the ground. Indian experts, however, believe that they may have been connected with some tribal religious rite.

By bending sharply, a man can place hands and feet in the mysterious lava prints



In this photograph, the impressions are chalked to make them visible to the camera



There's no danger of getting caught by this garage door

Device Stops Garage Door If Anything's in the Way

IF A new type of electrically operated garage door touches a person or automobile as it closes downward, an ingenious safety mechanism automatically stops its descent to prevent accidental injury or damage. A compressible, air-filled tube lining the bottom edge of the door is connected to a special electric switch. When the door edge touches an object, the air in the tube is compressed, opening the switch to halt the downward movement of the door. If desired, the device can be wired to reverse the movement of the door.

Job for Old Battleships

OBSOLETE warships may fight again as floating antiaircraft batteries, according to a plan proposed in England. Bristling with guns for use against hostile planes, the old vessels would be anchored permanently in important harbors, river mouths, and other strategic points. In shoal water, piling could be used to steady the hulls.

"PEDRO"

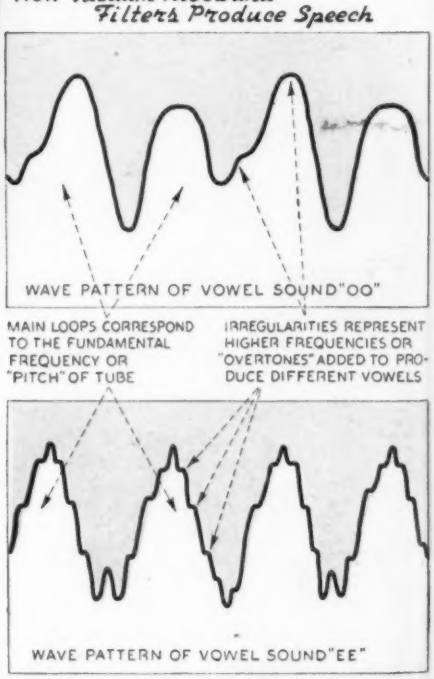
Seated at the keyboard of the Voder, this young woman can make "Pedro" say anything she wishes. The voice comes out of the loudspeaker

HE HASN'T any mouth, lungs, or larynx—but he talks a blue streak. His name is Pedro the Voder, and you may see him in action at the New York and San Francisco world's fairs. His creation from vacuum tubes and electrical circuits, by Bell Telephone Laboratories engineers, crowns centuries of effort to duplicate the human voice.

To manufacture Pedro's conversation, his operator employs a keyboard like that of an old-fashioned parlor organ. Thirteen black and white keys, fingered one or more at a time, produce all the vowels and consonants of speech. Another key regulates the loudness of the synthetic voice, which comes from a loudspeaker. A foot pedal varies the inflection meanwhile, so that the same sentence may state a fact or ask a question.

About a year's practice enables an operator to make Pedro talk glibly. He whispers or

How Vacuum Tubes and Filters Produce Speech


WAVE PATTERN OF VOWEL SOUND "OO"
MAIN LOOPS CORRESPOND TO THE FUNDAMENTAL FREQUENCY OR "PITCH" OF TUBE
IRREGULARITIES REPRESENT HIGHER FREQUENCIES OR "OVERTONES" ADDED TO PRODUCE DIFFERENT VOWELS
WAVE PATTERN OF VOWEL SOUND "EE"

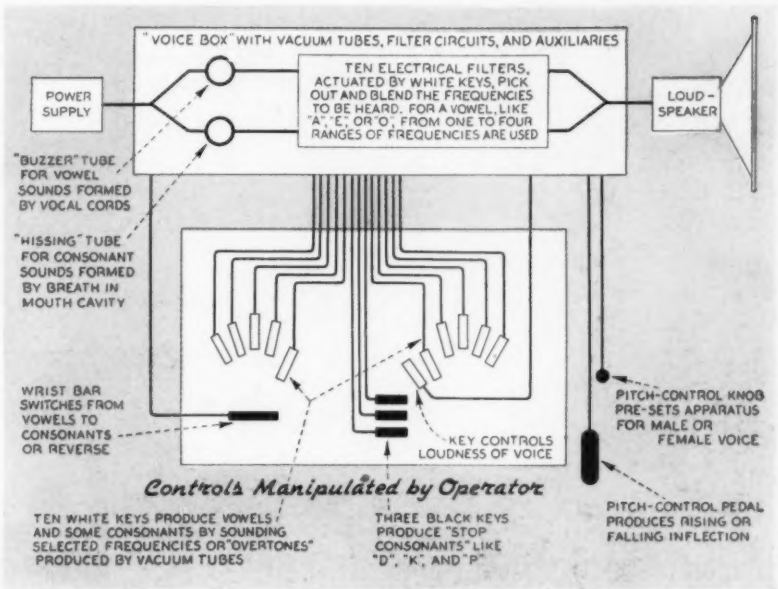
Voice-Operation Demonstrator Crowns Centuries of Effort by Scientists To Duplicate Human Speech Artificially

By ALDEN P. ARMAGNAC

—THE FIRST MACHINE THAT REALLY TALKS

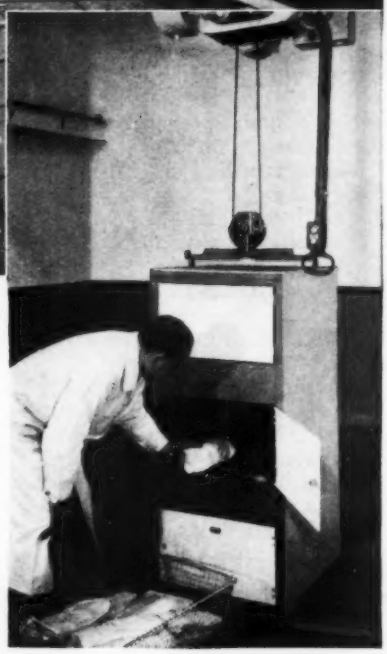
shouts, speaks with the voice of a man, woman, or child, and converses intelligibly in any language, despite his slight electrical accent.

More than as a potential stage star, however, Pedro's creators value him as an instrument to explore the mysteries of our own speaking mechanism. Two vacuum tubes imitate the two tones combined in human speech —the buzzing sound of the vocal cords, for vowels like "a" and "e"; and the hissing sound of breath passing through the mouth and lips, for consonants like "s" and "f." The keys operate electrical filters that transform the original tone into any desired speech sound, much as you shape your mouth to reënforce particular frequencies or "overtones" of the vocal cords.


"VOICE BOX" WITH VACUUM TUBES, FILTER CIRCUITS, AND AUXILIARIES
POWER SUPPLY
TEN ELECTRICAL FILTERS, ACTUATED BY WHITE KEYS, PICK OUT AND BLEND THE FREQUENCIES TO BE HEARD. FOR A VOWEL, LIKE "A", "E," OR "O," FROM ONE TO FOUR RANGES OF FREQUENCIES ARE USED
LOUD-SPEAKER
"BUZZER" TUBE FOR VOWEL SOUNDS FORMED BY VOCAL CORDS
"HISSING" TUBE FOR CONSONANT SOUNDS FORMED BY BREATH IN MOUTH CAVITY
WRIST BAR SWITCHES FROM VOWELS TO CONSONANTS OR REVERSE
KEY CONTROLS LOUDNESS OF VOICE
PITCH-CONTROL KNOB PRE-SETS APPARATUS FOR MALE OR FEMALE VOICE
Controls Manipulated by Operator
TEN WHITE KEYS PRODUCE VOWELS AND SOME CONSONANTS BY SOUNDING SELECTED FREQUENCIES OR "OVERTONES" PRODUCED BY VACUUM TUBES
THREE BLACK KEYS PRODUCE "STOP CONSONANTS" LIKE "D", "K", AND "P"
PITCH-CONTROL PEDAL PRODUCES RISING OR FALLING INFLECTION

Similar circuits gave an earlier "speech synthesizer" a sort of artificial voice (P. S. M., Feb. '37, p. 46), but some one had to talk into it to make it work. The new "voice-operation demonstrator," or Voder for short, owes its nickname to Dom Pedro, the Brazilian emperor who viewed Bell's newly invented telephone and exclaimed, "My God, it talks!"

Ten of the white keys seen in this photograph control different speech sounds; the eleventh controls volume. Black keys make the "stop" consonants. Drawing above explains operation



Individual locker raised from the floor by an elevated crane for food storage. The upper picture shows interior of the plant. Squares on floor are locker tops

Refrigerator Storage Lockers Sunk in Floor of Plant

A NEW type of refrigerated locker plant, designed for the use of householders and farmers who want to store individual supplies of meat and other perishable foods (P.S.M., March '36, p. 43), is now in service at Washington Court House, Ohio. Lockers measuring about six cubic feet in area are sunk into a refrigerated chamber below the main floor of the plant. When a person wants to store food, or withdraw it from his rented locker, an elevated crane is rolled into place and the chest hauled up within easy reach, making it unnecessary for him to descend into the ice-cold refrigeration room. Storage lockers are available in either of two separate areas, one kept at zero degrees Fahrenheit and the other at twenty degrees below zero.

Treads Let You Walk on Skates

Treads clipped over tubes and blades guard skates in walking, as seen at right

METAL treads that clip over the blades and tubes of ice skates permit the skater to walk to and from the ice without injuring either the skate blades or the surface on which he walks. Made of tempered steel, the skate walkers are spurred on the bottom to prevent slipping. When attached, the clips do not touch the sharpened surface of the skate blade.

Lighthouse Design Goes Modernistic

IT'S a far cry from the traditional lighthouse of the past, with its circular tower and perhaps a spiral stairway, to the streamline beacon shaft in the model pictured at the right. Yet this is just what the lighthouse of tomorrow may look like, in the opinion of architects who acted as judges in a recent competition sponsored by Cooper Union in New York City. The prize-winning lighthouse design, submitted by Helmut Riehl, of South Orange, N. J., calls for a structure of modernistic design with simple, flowing lines and surfaces, and little or no ornamentation. The beacon tower itself, braced by curving buttresses, juts into the sky above a double-deck observation platform at the end of a streamline, barrel-shaped building.

Model of a lighthouse of tomorrow. It won Helmut Riehl a prize in a contest

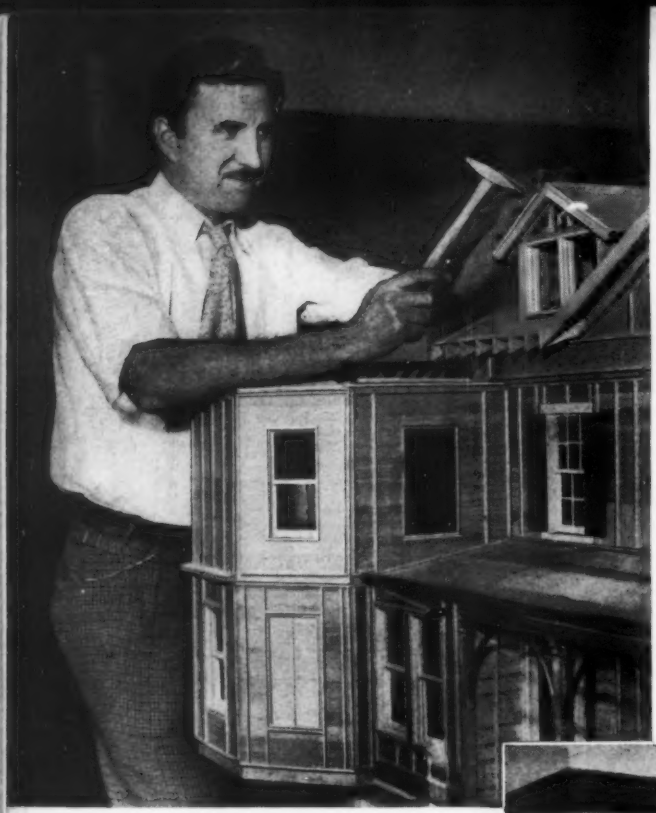
Lawrence Nicolas may go down to the sea in this odd "Washtub Clipper"

Washtub Sailor Plans To Drift Down the River

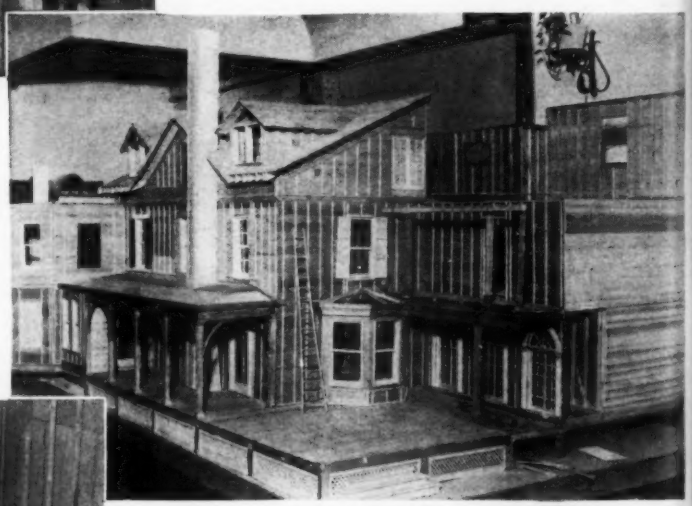
DRIFTING down the Mississippi River to the sea in a washtub is the odd stunt planned by Lawrence Nicolas, of St. Louis, Mo. Christened the *Washtub Clipper*, the strange craft consists merely of an ordinary galvanized tub supported in the water by an inflated tire inner tube. A metal rudder attached to the tub steers it. In the accompanying photograph, Nicolas is seen making a trial cruise in the craft.

Models Birthplaces of the Presidents

USING stones that have come from all the states and possessions of the United States, Robert MacKellar, of Peekskill, N. Y., is constructing a scale model of the Hyde Park, N. Y., birthplace of President Franklin D. Roosevelt. For years, MacKellar has been making exact scale models of the birthplaces of American presidents. Before he began his present task, he completed a model of the house in Virginia in which George Washington was born. All his models are built to the same scale, one inch to a foot. The Roosevelt birthplace is the most elaborate MacKellar has tackled. He estimates it will take him a year to finish it. The simplest dwelling in his series will be the log cabin in which Abraham Lincoln was born. MacKellar expects to complete this in a single day's work.



Robert MacKellar at work on his model of the birthplace of President Franklin D. Roosevelt, located at Hyde Park, N.Y.



At the right, the model is seen in the course of construction. It is one of a series of birthplaces of the presidents

Stones from all the states and possessions will be used in the model. Some of these contributions are pictured below

George Washington's birthplace at Wakefield, Va., as modeled by MacKellar. Like his other models, it is scaled at one inch to the foot

Mechanics Masquerade as Men from Mars

NOT weird, helmeted men from Mars, but merely airplane mechanics carrying metal propeller-hub protectors are pictured in the curious photograph reproduced above. Because of their unwieldy shape, the hub spinners were easier to carry when held over the heads of the workmen as they walked out to install them on giant 1,200-horsepower transport-plane motors. The spinners help prevent the formation of ice on propeller hubs during winter and early-spring flying.

Leonard Rodenhiser in the office of his one-man utility company at Sherbrooke, Nova Scotia. He looks like Abraham Lincoln

An Idea and a River Brought Him Wealth

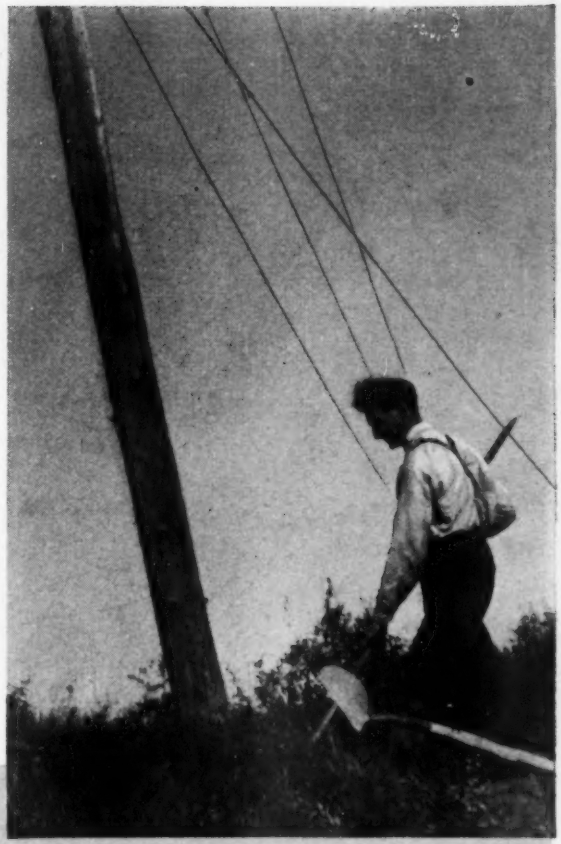
EIGHT years ago, a young man who looked somewhat like Abraham Lincoln came out of the dense spruce forests of Nova Scotia, with a daring idea in his head. He was practically penniless. He had just left his wife and children in their cabin in the woods and paddled across a lake to make his way on foot to the tiny village of Sherbrooke. His name was Leonard Rodenhiser, and he was ready to fight with the first Sherbrooke resident who should laugh at his idea.

He planned to start a one-man utility company to furnish electricity to the village. He was broke and he had no influential friends, either financially or politically. He had never been connected with a utility company, and about all he knew of them was what any man might read about the vast Canadian and American power systems. But he had an idea that a utility company could be owned and operated by one man if that man was himself, and he set out to prove it.

His background was not one to inspire

backers to dig into their pockets. Since an early age he had been a hunting and fishing guide, leading sportsmen to the moose, bear, and wild cat in the Nova Scotia forests, and to the best spots for salmon fishing. He knew the streams and rivers and forests of Nova Scotia better than most licensed guides, but that did not entitle him to backing as a utility magnate. Nor were people with money impressed by his years of experience with gold-mining companies, though they gave consideration to the fact that he had built many a log dam and had strung miles and miles of electric wire for the gold mines.

Even if he had wanted to sell stock to start his utility company, Rodenhiser would have found no takers. Most of what he knew about electricity he had picked up through haphazard experience, learning mainly through trial and error and remembering what he learned. He pointed out that he was a born mechanic, but nobody cared particularly. Nor were the moneyed men excited when he said he knew more about the power of the rivers in Nova Scotia than any other man in the vicinity, and he was certain there was enough power for cheap elec-



By HESTER ROBISON

One of the seven log dams that harness the waters of the Northwest Arm Brook, a tributary of the Saint Mary River, to light the village of Sherbrooke. Rodenhiser built them himself with the aid of friends. Above, the president of Sherbrooke Electric sets a pole

This pipe line, much patched and in some places held together with wire, leads water to the generator

The shingle-covered shack is Rodenhiser's power house. He has a Diesel generator for use in droughts

tricity to be had from the Northwest Arm Brook which flows into the magnificent Saint Mary River.

After a few days, he was practically talking to himself. By that time, he was more determined than ever and put his idea up to the residents of Sherbrooke themselves. If, he said, they would pay advance subscriptions at one dollar and seventy cents a month minimum charge for the first twenty-two kilowatt hours, with a rate of eight cents each for the next twenty-five kilowatt hours and four cents for all over twenty-five, he would undertake to provide Sherbrooke with electricity. Then he waited for the response.

Out of a population owning about one hundred buildings, only twenty-four residents were willing to take a chance. But that was enough for a start and Rodenhiser immediately applied for a franchise.

He was so impatient that he didn't wait for the franchise to be granted, but went to work as soon as he received a few dollars. He started collecting electric wire from whatever source he could find, even abandoned mines. Then he induced a few sturdy friends to help build a dam. Since there wasn't any money for cement and stone, he used logs. In a country where the forests come up to every man's back door, logs were cheap and easy to get. In a short time Rodenhiser had all the logs he needed for his dam, and plenty of poles to hold up his electric wire. The dam and the poles and the wire were only part of the equipment. Now he had to get a generator, no matter how primitive, and huge iron pipes to carry the water.

Much of this equipment he got from old mines and from factories which were willing to sell to a young man with a dream and no money. Then he built a small shack of shingles and frame to house his machinery and ran the pipe line, much patched and in some places held intact with the help of strong wiring and welding, right to the shack. Now he was ready to generate electricity for his twenty-four brave subscribers!

TO HIS surprise, the dam held, though the pipe showed unmistakable signs of leakage. Almost alone he had put up the poles, strung the wire, attached the electric meters. He worked day and night with not enough sleep or nourishment. Then came the day when the electricity was turned on and the first flickering lights appeared in the homes of his twenty-four subscribers. It was the greatest moment in Leonard Rodenhiser's life, and there was great excitement in the village. Then the new utility magnate learned

On inspection trips to his dams, the backwoods power magnate takes along a revolver and his police dog, Sally, for some hunting

that he had overlooked one prime factor: his franchise.

Under the law, until the franchise was granted he could not collect a penny for the electricity. It was his privilege to stop furnishing electricity to his subscribers until he could legally collect, but the people of Sherbrooke would have been offended at such a move. For three months he furnished power to his subscribers and collected nothing. At the end of that time only one man came to pay—and this experience taught Rodenhiser a lesson. To this day, when Mrs. Rodenhiser reads the meters, she hands a bill to each subscriber and collects on the spot. Nothing in the Sherbrooke Electric is left to trust.

As the years passed, the utility company expanded materially. But in all this time it remained a one-man affair. Leonard Rodenhiser was and is president, general handy man, sole owner, and staff. He *is* Sherbrooke Electric. His only assistant is Mrs. Rodenhiser, though for a brief time they engaged a free-lance bookkeeper to check on the finances.

In the seven years that have passed, Rodenhiser has dug more post holes than he can remember, has installed more poles and strung more miles of wire than he has counted. Day or night he answers complaints and personally makes repairs. It is President Rodenhiser who moves a pole from one side of a driveway to another to accommodate a subscriber. It is Rodenhiser who repairs pipes, replaces belts, oils machinery, fixes dams.

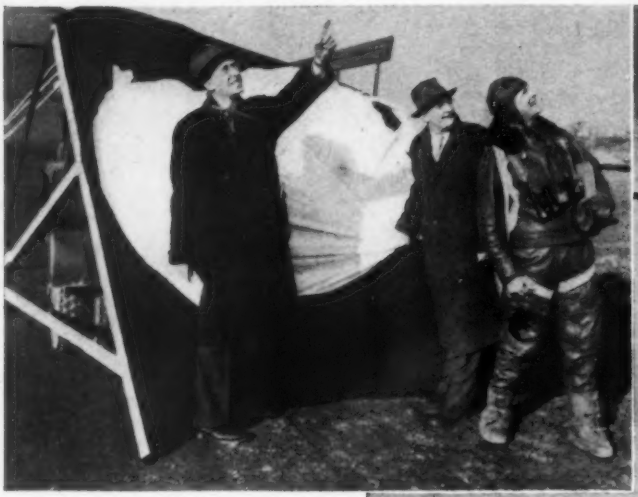
Rodenhiser's only assistant is his wife, who reads the meters, collects from subscribers, and does the company's simple bookkeeping work

Today he has eighty-four subscribers and the village of Sherbrooke pays him for the current for thirty street lights. He talks of stringing wire to Goldenville, a small mining community several miles away, and expanding to other villages that want electricity. Instead of one log dam there are now seven, stair-stepped back into the dense forests where they have to be inspected by President Rodenhiser at least once a month. And when he goes into the forests, the utility magnate is not above taking his police dog, Sally, and a revolver with plenty of ammunition.

On one tour of inspection he came face to face with an enormous bear. On another occasion a bear attacked his dog. Now Rodenhiser always carries a gun on his tours. Once in a while he forgets the dams and goes hunting.

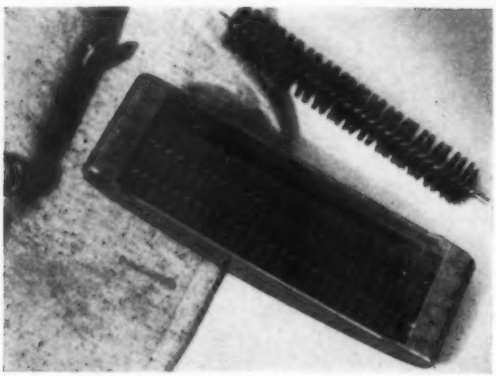
A few summers ago, an almost unprecedented drought so lowered the river level that for a while there was barely enough power to supply a flicker of light. The electricity was doled out, lights allowed for only two or three hours at night. But there were so many complaints *(Continued on page 238)*

"Silent Bombardment" Tests Autogiro



Moved about the field, this cloth "shell burst" was spotted by observers in the autogiro seen at right

TO TEST the usefulness of autogiros for directing artillery fire, as compared with airplanes and observation balloons, U.S. Army officers recently conducted an odd "silent bombardment" at a Philadelphia, Pa., airport. While observers hovered over the field in an autogiro, a special truck carrying black-and-white cloths arranged in a pattern that simulated a bursting shell, moved from point to point about the airport. The observers in the autogiro reported "hits" as in a real artillery duel.



The bristle units are easily removed for cleaning

Bristles of Clothes Brush Come Out for Cleaning

REMOVABLE bristles make a handy clothes brush just placed on the market easy to keep clean and in first-class condition. As pictured in the photograph at the left, the brush has two rows of bristles securely attached to spring-wire cores, which can be bent sufficiently to remove the units from the brush frame for cleaning. With the bristles removed, the inside of the frame can also be reached for cleansing. Separate rows of bristles can be obtained if it is desired to replace the original ones when they finally lose their shape and resiliency.

Microscopic Forge

TINY blades, needles, hooks, and other delicate microscopic instruments for laboratory research work are manufactured with infinitesimal precision by an electrically powered microforge developed by French scientists at the Pasteur Institute Laboratories in Paris, and pictured in use in the photograph reproduced above. Constructed mostly of glass and platinum, the diminutive tools make it possible to dissect minute specimens under the microscope.

Ash-Tray Stand Bends

A HEAVY metal spring that forms part of the stem of a novel smoker's stand enables the user to bend the stand toward him without tipping it over. When released, the stand rights itself automatically. The base of the unit is constructed of cast iron to give the stand a stable foundation. The stand's ash tray, however, is made of pottery, and can be readily removed for cleaning.

A spring allows the stand to be bent over for use

Bug Hunters Use Light To Trap Insects

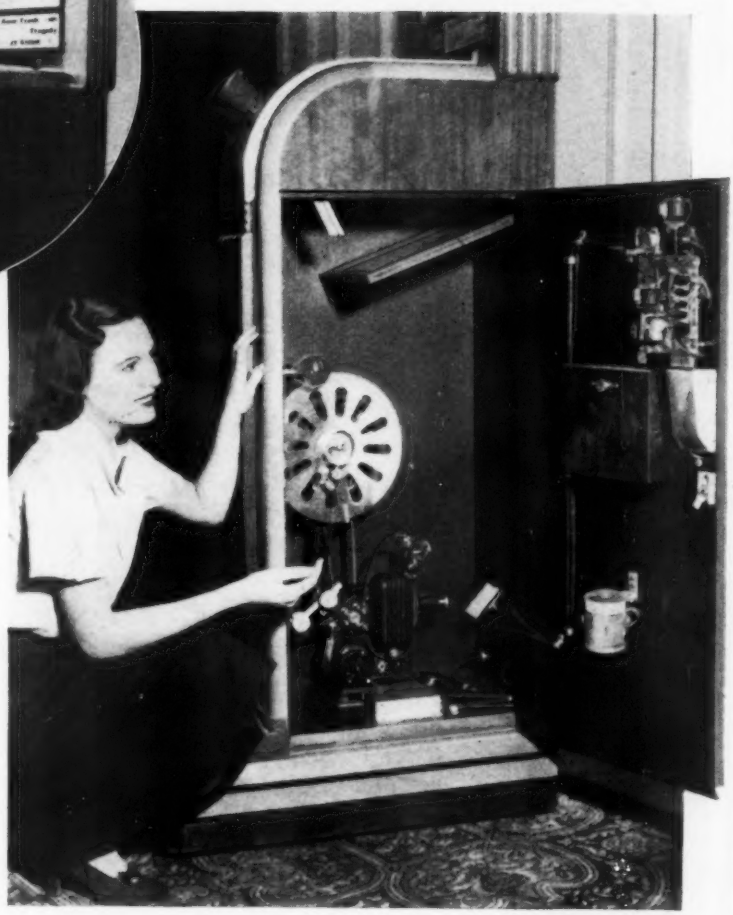
At the left, light is thrown on a screen to draw insects

Bugs are picked off the screen and bottled

HOW do commercial bug hunters trap the insects they sell to museums, laboratories, and private collectors? The answer to this question is revealed by the photographs above and at the right, showing insect hunters gathering bugs attracted to a white screen hung between trees and brilliantly illuminated. Insects are picked off the screen and killed by ether.

Movie Slot Machine Shows Pictures of Latest News Events

MOTION-PICTURE newsreels are on view for a nickel in a modern version of the old penny-arcade, animated-picture machine recently displayed at a Chicago, Ill., convention of manufacturers. As shown at the right, the device has a motion-picture projector installed in the base of its cabinet. Film images are thrown on a small mirror that reflects them up to a ground-glass screen near the top of the cabinet, where they are viewed through an eyepiece by a customer. Designed for hotel lobbies, railroad stations, taverns, and other public places, the movie machine is entirely automatic, running through four separate scenes when a nickel is dropped into the slot, and rewinding for the next customer when the film ends.



Inserting a nickel starts the newsreel movie which is viewed through an eyepiece. How the mechanism is arranged is shown in picture above

This watch fits the curve of any part of the wrist

New Watch Can Be Worn on Any Side of Wrist

A WRIST watch just put on the market can be worn anywhere on the wrist—top, bottom, or side—according to the owner's taste. Flexible bars at the ends of the watch automatically adjust themselves to the contour of the wrist, making it possible to move the timepiece to any position. Gold-plated, the watch has raised gold numerals that are stamped by means of a special process on the face of the dial.

Seedless Watermelon Produced by Student

WATERMELONS without seeds are produced by chemical treatment of watermelon blossoms, in a process perfected by Cheong Yin Wong, graduate student at Michigan State College, East Lansing. In the photograph, Wong holds a piece of seedless melon in his right hand.

Dirt Door Mats Block Germs

DOOR MATS made of loose dirt are a curiosity at a large railroad station in Switzerland. Placed at all entrances to the station, the dirt mats contain a disinfectant material to prevent railroad passengers and employees from spreading a scourge of foot-and-mouth disease affecting Swiss cattle by carrying germs on the soles of their shoes.

Bell Collection Makes Cash Register Ring

Miss Hazel Hicks with some of the 250 curious bells in her collection

WHEN failing eyesight forced her from her profession of teaching, Miss Hazel Hicks, of Cleveland, Ohio, decided to make her hobby of collecting bells profitable as well as pleasurable, and embarked on a lecture tour with the 250 specimens in her bell collection. During her talks on bell lore, Miss Hicks gives the history of some of her prize items: a bell from Oaxaca, Mexico, which was carved from lava; the oldest specimen in her collection, a Norwegian cowbell; and the heaviest, a nine-pound elephant bell from India. Bells from virtually every country in the world are included in the exhibit.

Why Nobody Can Steal

By AUBREY D. McFADYEN

A CURRENT movie depicts its hero as the true inventor of the electric refrigerator. The villain, a local mechanic hired to make some of the parts, gains access to the model. Before the hero can get in his application for a patent, the villain files one in his own name. Thus the hero is supposed to be robbed of his invention. If you haven't seen the movie, you may be glad to know that the hero stages a comeback and reaps a fortune by inventing and patenting the gas refrigerator.

Now, a note flashed on the screen before the play assures you that the characters are entirely fictitious. But perhaps you can't be blamed if you come away with the impression that the invention-stealing part of the plot could really happen. Fiction made up out of as whole cloth as this has given quite a number of people the same idea. The result is the absurd fear of so many inventors that their inventions may be stolen.

Each year, anxious inventors deluge their Congressmen and the U. S. Patent Office with letters, asking the name of some trustworthy patent attorney. One woman sent her son to Washington to select one, and have him obtain a patent upon an ointment she had invented. But she was so secretive about her concoction that not even the son knew the ingredients—which, the astonished attorney explained, must be stated with their proportions in order to obtain a patent. And I know of many inventors, seeking help at the Patent Office, who have suspiciously refused to reveal anything about the invention that would help in giving them the needed information!

Can anyone steal your invention? About patent attorneys, you need have no fears. In the first place, it isn't enough for a patent attorney to possess the necessary legal and scientific qualifications to practice before the Patent Office; he must also be able to satisfy it beyond all doubt that he is "of high moral character and good repute." And if at any time he should lapse from its high standard, the Patent Office would immediately disbar him. A patent attorney would be the last person on earth to rob you of an invention, then, for two excellent reasons—the Patent Office knows he isn't that sort, and the attorney, of all people, knows that he couldn't get away with it if he wanted to.

Looking back, I can recall only one instance when conflicting patent applications were found to have been filed by an inventor and his attorney. In that case, the attorney openly claimed he had improved upon his client's invention, and wanted to patent the improvements. A ruling of the Patent Office promptly squelched him, and established the principle that any improvements an attorney makes in a client's invention belong to the client.

It isn't a race to get to the Patent Office first

Nor need inventors fear that Patent Office employees may steal their inventions. Here again the inventor gets every protection. Not only is every employee fully investigated, and his character further tested in the crucible of the Patent Office before he reaches any position of responsibility. The law expressly prohibits him from patenting any invention of his own, from owning any interest in an invention, and from acting as an attorney or business representative for any inventor, as long as he is in the employ of the Patent Office. If he resigns, two years must elapse before he is allowed to handle any invention, in a field with which his official duties familiarized him, as an attorney or agent. It is a high compliment to

Explain your invention to a few reliable friends

Your Invention

Foresight eliminates costly court fights

HOW TO PROTECT YOUR IDEAS

HERE is your chance to take advantage of the knowledge and experience of a man who has spent a lifetime studying patent law and patent procedure. In this unusual article, Aubrey D. McFadyen gives you the inside story of the Patent Office, explains the little tricks used by famous inventors to protect their ideas, and outlines the steps you should follow to obtain an air-tight patent. As one engineer remarked after reading the story, "It's practically a four-year course in patent law."

the Patent Office that, throughout its 100 years, not one employee has ever been charged with stealing or misappropriating an invention in any way whatever.

For several reasons besides its good reputation, no "big corporation"—the bogey man of some timid inventors—is going to steal your invention. Quite likely, in fact, it will refuse even to look at your idea unless you have applied for a patent. This is sound business policy on the company's part. It does not want to run the risk of having its own research staff happen to duplicate your invention, and of being unjustly accused of copying it. If you have applied for a patent, on the other hand, the purchaser of your invention has reasonable assurance that his rights will not later be disputed by some other inventor.

How about unscrupulous individuals, then, who may steal your idea? Any applicant for a patent must make an oath that "he does verily believe himself to be the original and first inventor," and "that he does not know and does not believe that the invention was ever known or used before his invention thereof." Uncle Sam doesn't take this lightly, and making a false oath is a pretty serious matter, as you can judge from the rarity of cases on record. The last was in 1912, and the culprit was sentenced to the penitentiary.

Drawings mailed registered to yourself help prove priority

Just suppose, though, that someone like the movie-plot mechanic is willing to gamble with justice. The law that prevents him, and removes all need for fear and secrecy on an inventor's part, is both simple and brief.

Contrary to widespread belief, the first man to get to the Patent Office is *not* automatically the one who gets the patent. Instead, under the law's basic principle, the rightful owner of an invention is the one who actually invented it first—and can prove this, if necessary, by the simplest kind of evidence, such as the testimony of friends to whom he has shown it.

Framers of our patent laws realized the injustice of awarding a patent arbitrarily to the first comer. Heroes and villains conceivably might race, on that basis, to beat each other with their patent applications. Furthermore, a system like that would encourage inventors to rush to the Patent Office with half-baked ideas, to be sure of getting there first. Then, if an inventor's device proved a flop when he built and tested it, he would have been put to needless expense and disappointment.

What the law actually does, therefore, is to grant you a two-year period of grace between the date when you make your invention and the time by which you must apply for a patent to protect it. This gives you an opportunity to try out your invention, make sure it really is worth patenting, and develop it to its final perfected form before you apply for a patent. While you are doing so, nothing can impair your right to the invention.

The two years start officially from the date when you make your invention known to other people—show it to friends, or have a printed description of it published, for ex-

ample. As you can readily see, it is to your advantage to do this immediately. If you keep your invention a secret, some one else may hit upon the same idea, and you will have no proof to dispute his claim that he was the first to think of it. Compared with this, the possibility that some one may see your invention, copy it, and try to get a patent on it himself is a minor risk.

If anyone does try, you can still defend your rights successfully. When two or more applicants for patents claim the same invention, the patent law provides a fair way of settling the dispute. The applications are declared "in interference" with each other and they go to a department of the Patent Office that specializes in settling conflicting claims. This department will give you every opportunity to prove you made the invention first, and will award you the patent if you can do so.

You must present as witnesses the people to whom you disclosed your invention, for examination and cross-examination, just as proof is presented in a courtroom. These witnesses must understand thoroughly what you explained to them. The Patent Office corps is expert in analyzing testimony. Probably no other judicial board can boast a better record for accuracy of its findings. In case any party remains dissatisfied with its decision, however, he can still appeal to one of several courts, and have the entire record reviewed.

The odds are about fifty to one that you will not meet a conflicting claim

To decide who first made an invention, the Patent Office experts take into account all the evidence, circumstances, and reasonable probabilities. They consider what kind of invention it is; the businesses or professions of the rival inventors; how these rivals might fairly be expected to compare in inventive ability; and the reasonableness of the testimony given by each of the claimants and his witnesses.

The adding machine was claimed by 185 inventors

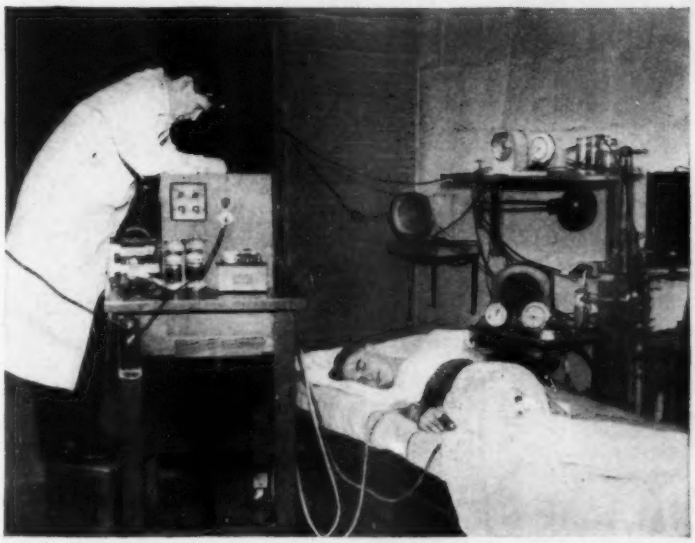
Several other fellows may have had the same idea

One recent interference case, for example, involved two applicants. Each claimed he was the first to invent a metal "muzzle" or shield to prevent chickens from pecking each other. One of them, who happened to be the second to apply for a patent, proved that he had been in the chicken business for years; that he had talked over with others the problem that his invention solved; and that he had explained his invention to them. The other claimant lived in a city. He had never raised chickens, and knew nothing about it. Asked how the idea had ever occurred to him, he was unable to give a plausible explanation. The poultryman was awarded the patent.

Here is an interference case, in the medical field this time, that bears many of the earmarks of the movie about the refrigerator inventor. But this one happened in real life, and the outcome speaks for itself. A scientist had sought for years an improved way of weakening germs for use in vaccination. As is well known, individuals may be inoculated against many diseases by injecting a quantity of dead or weakened bacteria in the system. Finally the scientist hit upon the scheme of rupturing them. He did this by slowly placing the bacteria under tremendous pressure, and then suddenly releasing the pressure. The internal pressure stored up in the germs thereupon exploded them, much as grains of rice are "puffed" to make a breakfast food. To create the high pressure necessary for the process, he hired a mechanic to build a powerful hydraulic press. When the scientist applied for a patent on the germ-weakening idea, he found the mechanic also had filed a patent application. An interference was declared. Testimony speedily brought out, however, that the mechanic's training could not possibly have qualified him to invent the scientist's process. Called on to explain it, the mechanic *(Continued on page 234)*

Scientific Tests Show How We Sleep

WIRED to a maze of technical apparatus, the sleeper pictured at the right is undergoing one of thousands of experiments dealing with the phenomena of sleep, being conducted by University of Chicago scientists. One instrument checks the electrical resistance of the sleeper's skin, another records his movements during the night, and a third registers variations in breathing. The tests show that most of us sleep too much, that daytime naps do not impair sleeping at night, and that most persons who depend on alarm clocks to awaken them, actually wake up half an hour before the alarm sounds.

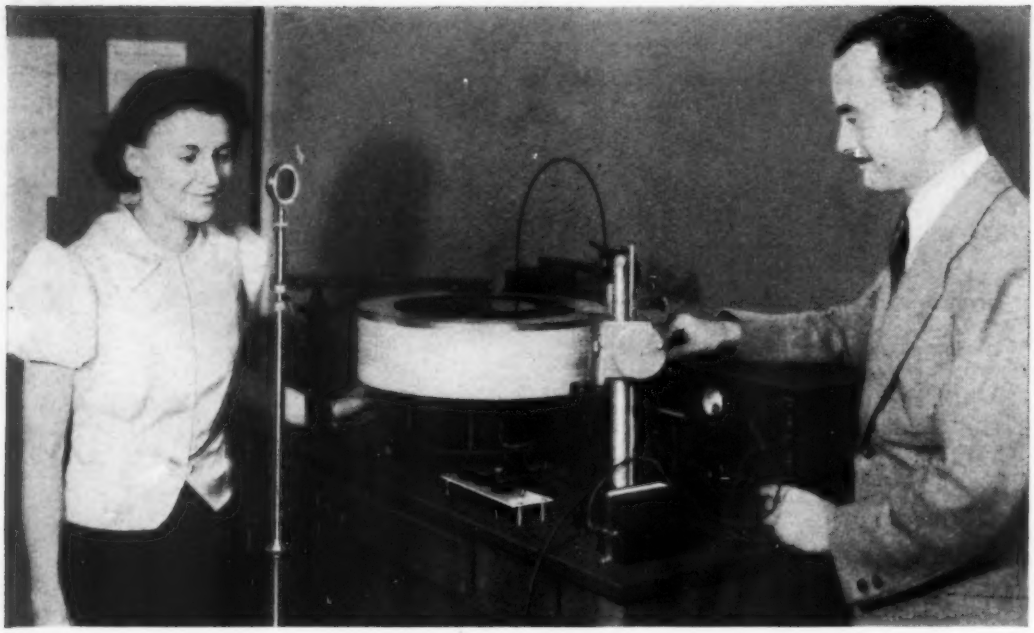


While the subject sleeps, a scientist checks readings on the instruments

Ground worker plugging the mobile battery unit into a plane's electrical supply

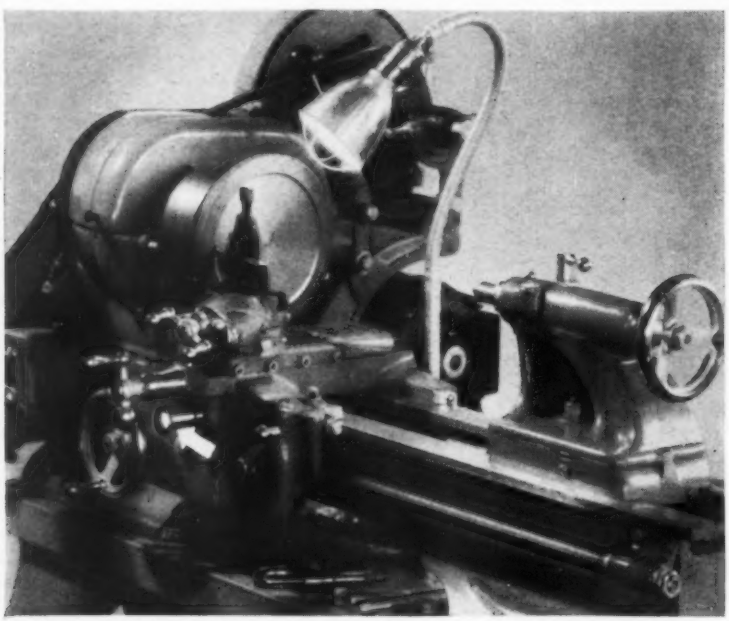
Battery Cart Saves Plane's Power Supply

POWER that is stored in a transport plane's electrical system is conserved while the ship is being overhauled or serviced by a mobile electrical cart used by a major air line. Containing two twelve-volt storage batteries, the cart is wheeled beneath a plane's fuselage and plugged into the ship's electrical system. Thus the airliner's crew can operate cabin lights, test the plane's radio, and check the electrical meters and gauges on the instrument panel, without draining power from the plane's batteries. The cart also carries a hand telephone with which mechanics working below the plane can talk to men inside the ship.



New Voice Recorder Aids Study of Speech

CALLED the only laboratory unit of its kind in the world, a novel electric recording machine invented by Dr. M. D. Steer and Dr. Joseph Tiffin, of the speech clinic at Purdue University, Lafayette, Ind., will make phonograph records, play them back, record music or speech on film, or project sound waves in visual form on a screen. The intricate device, called the vibrograph and shown in use in the photograph above, is being used to gather data for research studies on the effects of training, heredity, and other factors that may influence the development of the speech of children, students, and adults.



New home-workshop lathe. Arrow points to control button of power cross feed

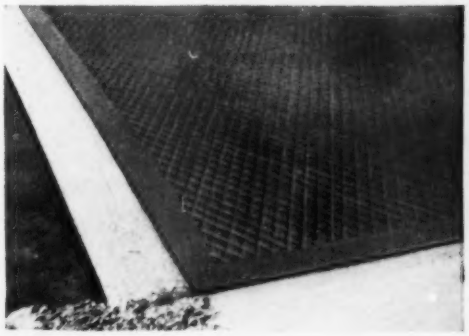
Home-Workshop Lathe Has New Features

A POWER cross-feed mechanism for the cutting tool is provided as standard equipment on a home-workshop lathe just introduced. Having a ten-inch swing, three-foot bed, and eighteen-inch capacity between centers, the unit incorporates a newly designed carriage, new horizontal bench-type countershaft, and new headstock safety guard. In the close-up at the left, the arrow indicates the button used to control the power cross feed.

Nonskid-Tread Road Gets Tryout

Workmen laying trial section of skidproof road. Drying mats give a treadlike corrugated surface, as below

A 3,500-FOOT stretch of corrugated road, constructed as an experiment by the Pennsylvania Department of Highways, is being checked to determine its effect in reducing skidding and cutting down sun glare. On a bed of concrete laid down by the quick-drying vacuum method, (P.S.M. May '37, p. 42), ridges like those on the tread of an automobile tire are formed by mats used in the drying process. During a test period, an average of 3,000 cars a day passed over the corrugated road with no accidents being reported. Highway Department engineers predict that the new road surface, if successful in all tests, will become standard.



A "voter" getting a flavored tablet to test her taste reactions

Palate Ballot Tests Tasters

How much does the sense of taste vary among different people? To find out, Dr. A. F. Blakeslee, of the Carnegie Institution, Washington, D.C., gave specially flavored tablets to delegates to a science convention in Richmond, Va., and then tabulated their reactions on a standard voting machine, as shown in the photograph at the left. Subjects were asked to "vote" according to the way the tablet tasted when first put into their mouths, and also how it tasted later on as it dissolved.

Eyeglasses

BY MENTIONING that her dog seemed nearsighted, a girl customer started an optician of Geneva, Switzerland, on his way to becoming a specialist in fitting canines with glasses. Not only did he succeed in curing her pet, but now he has found a novel and profitable career in applying his newly discovered methods to other four-footed subjects.

Many dogs are known to suffer from defective vision, especially nearsightedness. Others need tinted eye shades after eye operations. For these reasons, a number of inventors have tried to pro-

This canine customer is being fitted with glasses by Robert Muller, Swiss optician. A test lens is being inserted in a frame made to the dog's measure

Since a dog can't be asked to read letters on a chart, a dry, odorless bone is dangled in front of him. If he shows any interest, the optician knows that the test lenses are right

The vision of each eye is tested separately by an instrument called a refractometer, seen at the left

for Dogs

duce glasses suitable for dogs, only to fail because the animals found the spectacles uncomfortable or could not keep them on. The design created by Robert Muller, the Swiss optician, is declared to be the first to overcome these objections. Attached to the dog's collar, a light metal frame resting on its head supports the glasses, which are secured firmly in place by an elastic band passing under its jaws.

Arriving at the eye clinic, a pet undergoes a thorough examination with the aid of up-to-date scientific instruments. One of them measures the distance between one eye and the other, so that the breadth of the spectacle frame may be proportioned accordingly. Another instrument determines the curvature of the eyes, to aid in prescribing the proper corrective lenses.

When this has been done, the optician verifies his prescription, just as he would with a human patient, by inserting test lenses in an empty frame until he finds a pair that exactly suits the dog's eyesight. Since rows of letters and other standard test charts are useless for these trials, he has devised an ingenious expedient.

A dry bone is covered with fat and given to the dog, which is allowed to lick off the bone for several days in succession. Thus the dog becomes accustomed to the outline of the bone. Later, the same bone, with all trace of odor removed, is suspended fifteen feet away from the animal. The lenses are then tried out. When the dog notices the bone, the optician knows that he has the proper fitting.

Here Muller is measuring the distance between the dog's eyes to determine the proper breadth and proportions for the frame

The photograph at the left shows how the frame fits on the animal's head. At right, the dog, now accustomed to his glasses, walks with his mistress

Dunking Tests Doughnut Tires for Airplanes

DOUGHNUTS for giants, frying in a monster vat, might make a picture like the one at the right. Actually the enormous "sinkers" are new tubes for airplane tires, ready to be submerged in a tank of water while the young woman in the illustration looks for air bubbles that would betray leaks. She hasn't found a leaky tube in years, according to the maker, but the tests go on just the same as part of the regular manufacturing procedure.

Airplane-tire tubes about to be submerged in water as a test for air leaks

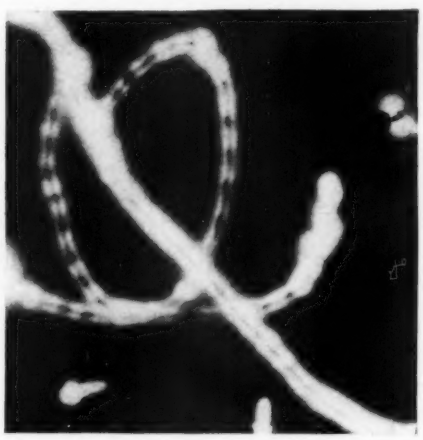
Sealed at one end to make it buoyant, the telescoping, waterproof drinking straw bobs up when bottle is opened

Drinking Straw Pops Out When Bottle Is Opened

DON'T be surprised, when you open a bottle of your favorite soft drink, if a clean, sanitary straw pops out of the beverage. It's the latest wrinkle in bottling and may make a fortune for its clever inventor. Inserted when the bottle is capped, the waterproof straw is closed at the top, trapping air that makes it buoyant. For use, you simply pinch the top to open it, and extend the telescoping straw so that it will be long enough to reach the bottom of the bottle.

Glowworm's Portrait Is Traced on Film

WHEN a fellow worker brought a glowworm into his darkroom, Herman Edwards, newspaper photographer of Portland, Ore., dropped the insect upon an unexposed film. After poking it into activity, he developed and printed the picture. The result was the odd self-portrait reproduced below, in which a streak of light records the meanderings of the luminous creature across the sensitive emulsion.



Self-portrait of a glowworm, traced by the luminous insect on a piece of unexposed film

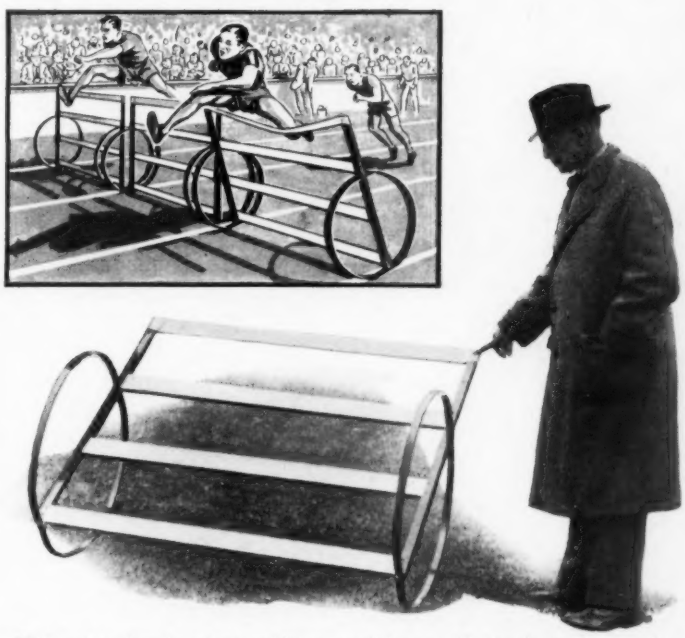
How'd you like to meet the moose that wore these? They have a spread of nearly six and a half feet

Museum Gets Huge Alaskan Moose Antlers

A SET of moose antlers with a spread of six feet, five and five eighths inches, said to be the second largest ever seen, has just been placed on display at the American Museum of Natural History, New York City. The antlers weigh sixty pounds, and were discovered by Alaskan guides, last October, upon the dead body of an old bull. The animal, apparently mortally wounded in combat with a younger and stronger rival, had drowned while making a desperate effort to cross the Kasilof River.

Safety Hurdle Rolls Over If Jump Fails

IF AN athlete fails to clear a hurdle of new design, he risks no injury. In contrast with the conventional type on inverted-T-shaped standards, the new style, when struck, does not rise before tipping completely over. Instead, the hurdle yields to less than a pound of force upon the top bar, by rocking on circular rims that act like wheels. Invented by Harry Hillman, track coach at Dartmouth College and former Olympic champion, the new hurdle gives increased self-confidence to athletes. It is reported to have been adopted by several large colleges.



This safety hurdle gives athletes confidence. If struck, it tips easily

Two-in-One Gas Hose Aids Oxyacetylene Welders

IRKED by the tangled mass of rubber-hose gas lines surrounding welding apparatus, a Buffalo, N. Y., technician recently developed a molding process by which the acetylene and the oxygen lines leading from storage cylinders to a welding torch are neatly joined into a single unit by a membrane of rubber.

Handy New Drawing Tool Makes Parallel Lines

TWO pencils, pens, knives, and a drawing compass are contained in one handy drawing tool just introduced. Shaped like an inverted letter T, the instrument makes it easy to draw parallel lines, ribbon letters, arcs, scrolls, borders, and other decorative patterns, as pictured below. Drawing accessories, easily attached to the unit's crossbar, include two compass points, three cutting blades, double pen equipment, and four pencil leads.

Three uses of the novel drawing tool are pictured here. It holds the twin cutting blades, two pen points, and pencils inside its hollow handle

Polarized Light Settles Court Dispute

HOW an eye specialist recently used one-way light to prove that a woman could see equally well with both eyes, is being demonstrated at the right. The woman donned glasses having polarized, or one-way-light lenses, rays vibrating vertically being admitted by one lens, those vibrating horizontally by the other. While reading a projected chart, she failed to stop reading aloud when the illumination of the chart was suddenly switched from vertical to horizontal polarized light, proving that she was seeing equally well through both lenses, and therefore with both of her eyes.

While the subject reads through polarized lenses, lighting is changed

Motor-Cycle Engine Runs Amphibian Car

BOAT and automobile are combined in a curious amphibian vehicle designed by a German inventor. Powered by a motor-cycle engine and steered with motor-cycle-type handlebars, the strange craft has a water-tight body supported by three diminutive wheels, the single rear wheel being used both to drive and to steer the vehicle on land. In the water, a propeller mounted on a hinged shaft is lowered below the surface and shifted into gear with the engine to drive the boat at twelve miles an hour.

Here the odd vehicle is running on land. When it is used in the water, as in the upper picture, the hinged propeller shaft is lowered beneath the surface

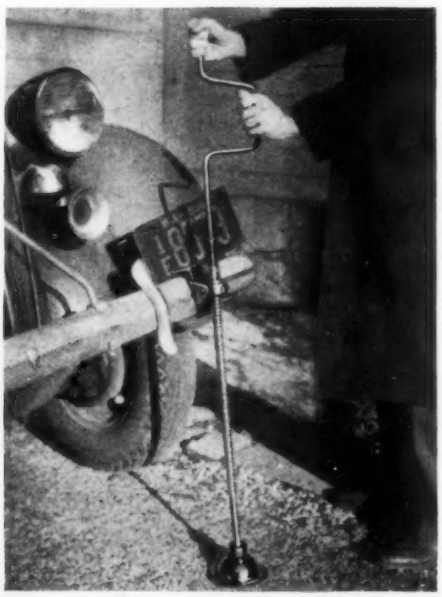
Quinter Bashore with one of the sun lamps that keep his lemon trees warm

Heat Lamps Guard Trees from Frost

INFRA-RED-RAY heat lamps, of the type commonly used by doctors for giving patients electrotheraphy treatments, have been adopted recently by Quinter Bashore, Covina, Calif., fruit grower, as a means of protecting his lemon groves from nighttime frosts. The lamps, 128 in number and each of 260-watt size, are connected to power wires strung on poles spaced along rows between the trees in his 2½-acre orchard. In addition to the actual heat that is given off by the lamps, infra-red rays, Bashore believes, keep the chlorophyll, the light-absorbing green coloring material in leaves, active throughout the night, so that neither foliage nor fruit will freeze.

Improved Auto Bumper Jack Takes Load from Any Angle

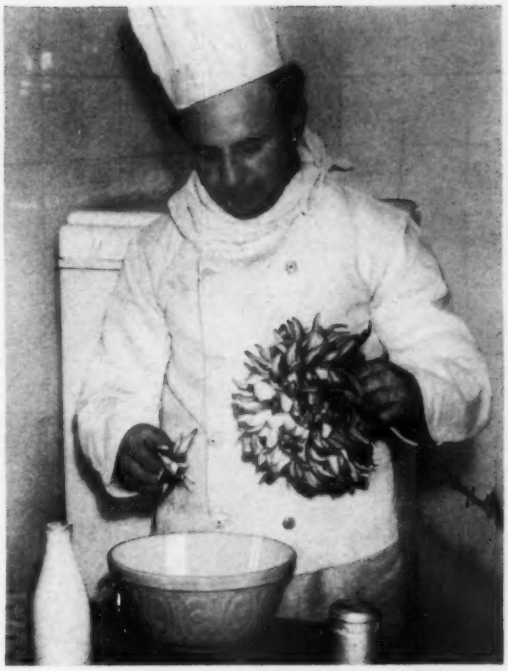
A TWO-TON vehicle can be raised easily with only a small, six-inch ratchet wrench by means of an improved automobile bumper jack, according to its developers, Ethan I. Dodds and Morgan S. Elmer, of Central Valley, N.Y. In screw-type bumper jacks heretofore used, the inventors claim, the weight of a vehicle, when applied at even a slight angle away from the vertical, had a tendency to bind the jack screw, pressing unevenly on the screw threads and thus making it harder to turn the jack handle. The new jack, however, has a universal joint which takes the weight of a car from any angle and distributes it evenly on the jack-screw threads.



The new jack in use. A universal joint, seen at the left, keeps the screw threads from binding when weight is applied from the side

Chrysanthemum Petals Used in Novel Soup

CHRYSANTHEMUM petals, soaked for two minutes in boiling water, and added to a recipe calling for milk, butter, corn meal, and spices, make a Japanese cream soup which has won praise from a London, England, chef. He is shown in the photograph at the right adding the petals to the concoction, which requires "one large chrysanthemum—any color." He describes the taste as "very palatable."



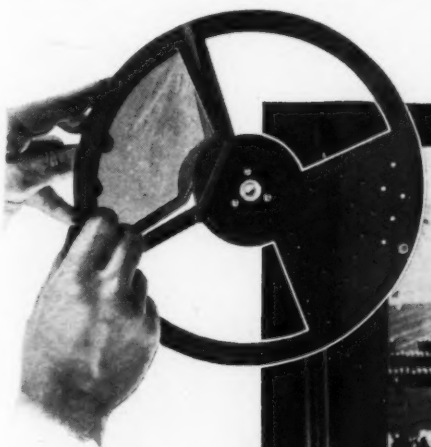
Adding chrysanthemum petals to flavor the new soup

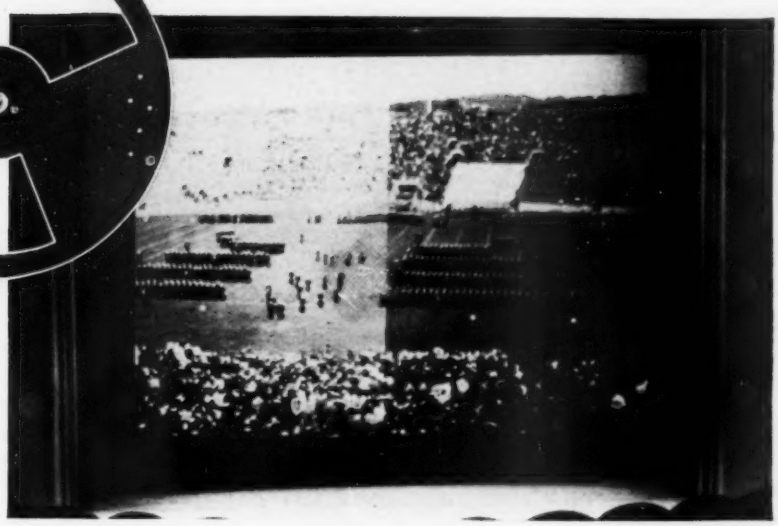
Automatic Case Ejects Keys

FITTING a vest pocket or hand bag, a wafer-thin metal key case just introduced has an ingenious mechanism that pops out the right key when a small button is pressed. It is available in two styles, one holding two, the other four keys. The case is seen at the left.

New Shutter Filter Makes Movies Brighter

A NEW shutter available for professional-type motion-picture projectors is claimed to increase the brilliance of pictures thrown on the screen by as much as twenty-seven per-cent. By employing a special filter in the rotary shutter, only clear, blue-white light is permitted to reach the projection screen. This light is said not only to make pictures easier to see, but to increase their sharpness as well. The shutter, with renewable filters, is available in sizes adaptable to every make of projector in general use. At the left, a new filter is being inserted in the shutter.





The right half of the scene at right was projected without the filter. Note its dark tone. Above, how filter is put into revolving shutter

Pierro San Salvadore, Italian artist, painting at the Royal Exchange in London with volunteer sidewalk art critics appraising his efforts

Barrow Carries Artist's Kit

WHILE making paintings of street scenes and famous buildings in London, England, Pierro San Salvadore, celebrated Italian artist, trundles his painting paraphernalia from place to place on a homemade two-wheeled barrow. Folded compactly, the artist's easel, color box, and other items of equipment are strapped securely to the novel carryall, while small articles are accommodated in a haversack fastened to the side. In moments of relaxation from his work in the streets, the painter takes a portable stove from his "pack horse" and brews himself a cup of tea. San Salvadore devised the barrow for use on a painting tour of Scotland and the Isle of Man before taking up his residence in London, but finds that the handy cart maneuvers as well on the sidewalks and cobblestones of the city as it does in country lanes. According to the artist, London offers greater possibilities to the painter than any other city in the world, because of the light values in its unusual climate.

Going to work, San Salvadore trundles his equipment through the streets on this handy homemade barrow

Time out for a cup of tea made on a portable stove

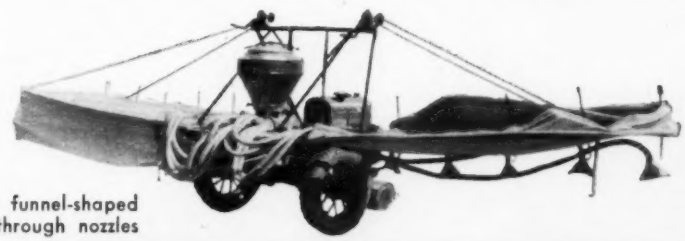
Furrows form small trenches to prevent washing of the topsoil

New Seeder Plow Checks Erosion

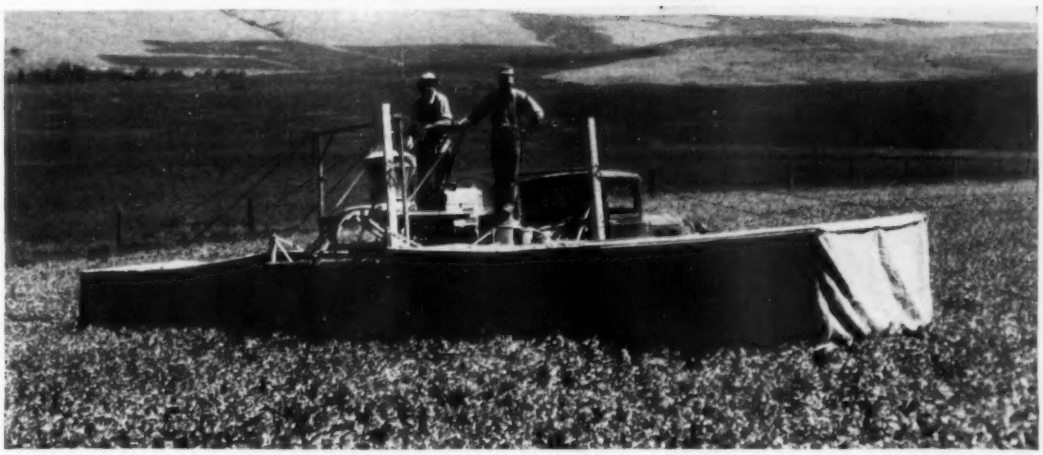
LARGER crop yields and prevention of soil erosion are two advantages claimed for a novel combination plow and seeding machine. When drawn along the slope of a hillside field, the machine in a single operation cuts narrow furrows and also deposits seed and the correct amount of phosphate fertilizer. Since the furrows follow the contour of the slope, they form small trenches to trap and hold the rainfall, thus preventing the water from washing away the topsoil. In tests of the device last year on 1,500 acres of hillside land, farmers reported a grain yield twenty-five percent greater than in former years.

Dusting Truck Fights Pea-Vine Weevils

TO COMBAT the weevils that destroy pea vines, Oregon State College agriculturists developed the insecticide-dusting machine shown below. Mounted on the back of a truck, the duster is driven through the pea fields, while compressed air blows insecticide through nozzles directly onto the vines. To prevent high winds from carrying away the dusting material as it is being applied, the machine wears a large burlap apron that hangs down around the dusting nozzles. Small iron rods placed at the lower edge of the apron hold the burlap in a vertical position.



Insecticide fed into a funnel-shaped hopper is blown out through nozzles



The machine in use for dusting pea vines with insecticide. A burlap apron shields the nozzles from the wind

Roy Seawright painting out part of an actress' figure in an image thrown on a screen for rephotographing

MAKING

Movie Actors Disappear

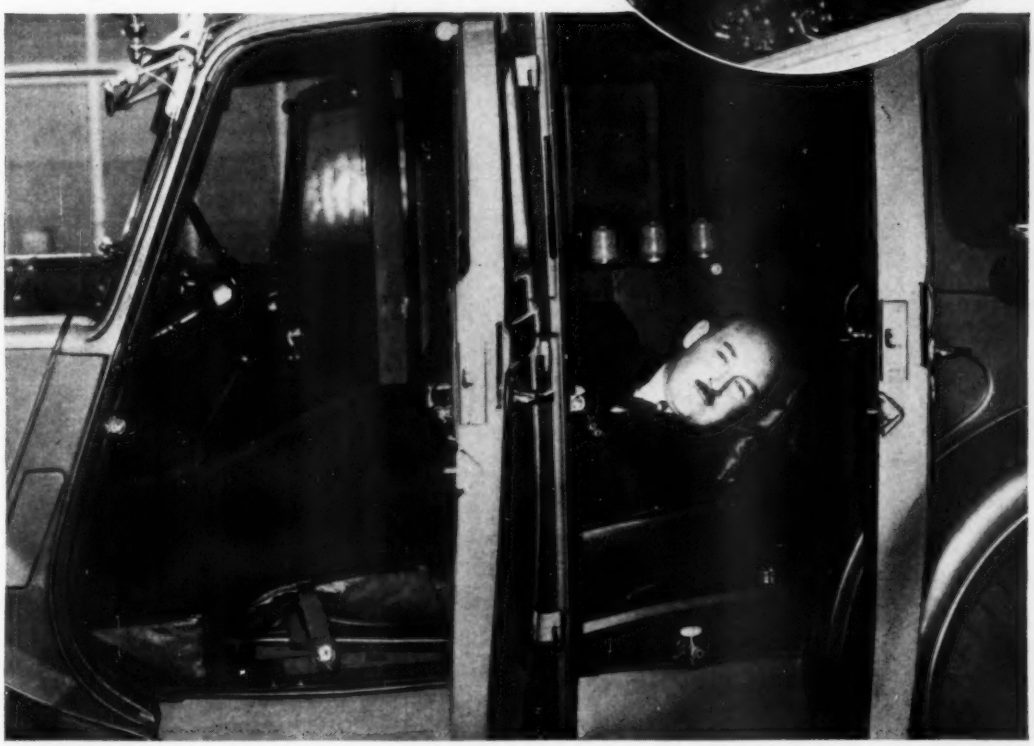
AN ACTRESS passes her hand down in front of her body—and her head, shoulders, waist, and feet vanish in succession from the screen. These views show how the disappearing stunt is done, in the recent motion picture "Topper Takes a Trip." Projecting an individual frame of the film on a screen, Roy Seawright, movie magician, painted out a little of Constance Bennett's figure and rephotographed the frame on a few film. With each of thirty-three succeeding frames, he painted out a bit more. Corresponding sections of the background were printed on the final trick film in perfect register, through masks that covered all but the previously blocked-out portion of every frame.

Five stages in a trick disappearance scene in which a character vanishes gradually from the screen. Read how this movie stunt is performed

Motorist Charts African Roads

EQUIPPED for any hardship or hazard of the road, an English motorist, H. E. Symons, has left by automobile to motor from England to Cape Town, South Africa, 10,000 miles away. An object of the expedition is to make a motor-road survey of Africa which may help to establish a year-round commercial and military route through the interior. Carrying special stoves, water, provisions, and sleeping accommodations, all in a small car, Symons has on his itinerary crossing the snow-covered mountains of central France, spanning the Sahara Desert, traversing the African continent from west to east, and then going south to the cape.

H. E. Symons packing one of the water-tight food lockers at rear of his car. In circle, food can warming on the engine manifold so Symons can keep driving until meal time



How the car seats can be arranged to form bunks. Note the spigot on the built-in drinking-water tank

Raymond L. Ditmars, curator of reptiles at the Bronx Zoo in New York City, demonstrating the use of the electric snake-milking device described in this article

Electric Shocker

EXTRACTS VENOM FROM SNAKES

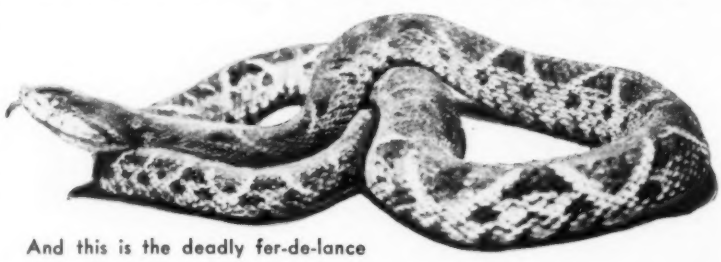
"THAT'S the feller who knows all about snakes. He's invented some electric dingus in that box to pump the poison out of 'em."

Such was the remark overheard by the writer as he entered the "snake farm." It just shows how wrong ideas get started.

To begin with, the writer doesn't know ALL about snakes, by a long shot. Nobody does. And he has *not* invented an electric pump to extract venom from snakes.

The idea of milking poisonous snakes electrically came, not from the writer, but from Dr. Carl M. Johnson of the Gorgas Tropical Research Laboratories here in the Canal Zone. Dr. Johnson did it first, and he very kindly made the writer acquainted with his system. Then the writer took some electrical equipment originally designed for an entirely different purpose and altered it slightly for milking venomous snakes. But here's the story:

Dr. D. D. H. "Hard Luck" March, who makes his living running a zoölogical park, trading in animals, and more particularly



And this is the deadly fer-de-lance

By VAN ALLEN LYMAN

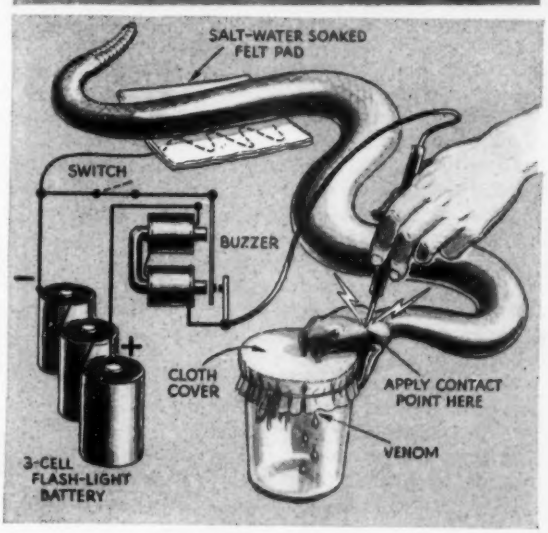
specializing in snakes and snake-venom extraction, wasn't satisfied with the usual method of pressing venom from a snake's poison glands with the fingers, and asked the writer to help in the matter of venom extraction by electricity. Both of us already knew of Dr. Johnson's work along this line, and he willingly showed the equipment he used and explained his methods. The writer supplemented it by devising a simpler and cheaper apparatus, which can easily be assembled by anyone anywhere who might be interested in such matters. Cost, a dollar or less.

Poison is extracted from snakes for two reasons. First, just to show that it *can* be done, and for the hell of it. The same spirit that makes people do stunts on the flying trapeze. Second, for use in medical laboratories where it is made into snake-bite cure and other things, particularly a remedy to stop bleeding.

The usual method of poison extraction is to hook the snake's fangs over the edge of a glass cup and squeeze on the side of its head with the fingers. This compresses the poison glands and the poison comes out through the hollow fangs and runs into the cup. It is yellow in color and looks like orange juice. The snake is securely held by hand during the procedure, and as it naturally opens its mouth to bite, its fangs are hooked over the glass's edge. That's all there is to it. Just use discretion and good judgment, and don't maul the poor snake.

The hand method gets out the poison, all right, but along with it a certain amount of mucus from the snake's mouth and also sometimes a little blood in event the snake injures its mouth by biting violently on the edge of the glass or biting its own mouth, as sometimes happens. Pressing on the snake's head to express the venom is injurious to the snake and starts fibroid conditions, so that the amount of venom obtained on subsequent milkings will be continuously lessened.

Electrical current applied to muscles tends to make them contract. Therefore, if an electric current is passed through the muscles operating a snake's poison glands, the poison will necessarily be squeezed from the gland and expelled in a natural way. This means a minimum of handling



In the circle at top of page is the business end of a rattlesnake. Photograph and drawing show the electric milker devised by the author, and the method of using it

Here's the usual way of getting venom from a snake. The reptile's head is squeezed to compress the poison glands

and injury to the snake, and the poison obtained will be clean.

Dr. Johnson has been doing his work with a small induction coil operated by two dry cells. The shock from it isn't much, maybe ten volts or so, but it does the work nicely. Such coils are, however, not generally available. The writer, desirous of using easily obtainable equipment and keeping the costs low, found that similar results could be had by using the inductive "kick" obtainable from a small common signal buzzer or bell, and three flash-light cells. Two wires for contacts are taken from the buzzer circuit in such a way that they get the inductive "kick" of the coils as the buzzer vibrates, and though the flash-light battery is only around four volts the induced "kick" from the buzzer is considerably higher, enough to cause a strong muscular contraction.

This electrical power is sufficient. Lay off any bright idea of using automobile spark coils. If you try these, you deserve to get bit. All you want to do is to stimulate the snake to spit out all his (or her) venom, and the power mentioned is about right. Remember you are robbing the snake anyway, and no need to torture the poor thing.

This is how you use the electric venom extractor: One insulated wire from the apparatus terminates in a sponge or cloth pad wet with salt water and held against the snake's body anywhere. The other wire terminates in an insulated handle and a small wad of cotton also wet with salt water. With the snake's fangs hooked over the glass, this is pressed firmly against the snake's upper cheek about midway between the eye and back of head, outside and above center. The exact point must be determined by experience.

Does the poison come? I'll say it does! It comes with a gush, as those muscles contract under the electrical stimulus. Clean and pure, nice "orange juice." You have to touch both sides, of course, alternately, just as you have to milk the different teats on a cow. Don't overdo it, for the muscles have a "fatigue period." Do it right and you'll get everything. It doesn't injure the snake, and two weeks later, at least in this part of the world, you can milk it again. Our local bushmasters and fer-de-lance snakes, and the big tropical rattlers, will give from one to two cubic centimeters of venom at a milking. These are sizable snakes, of course. There is no use wasting time with shrimp-size specimens.

How is the poison handled after it is obtained? Well, if you want the straight of it with all the five-dollar words left out, here it is: You put it in a small laboratory centrifuge, the same sort of thing as is used for testing oil or milk. Then you spin it until all the impurities have been thrown to the bottom of the tubes by centrifugal force. Then you pour off the pure poison and throw away the sediment, using discretion as to where you throw it.

The pure poison is then dried. In the laboratory here, a vacuum drier is used. The dried venom, ready to be sent to commercial laboratories, is granular in form and looks much like a breakfast cereal.

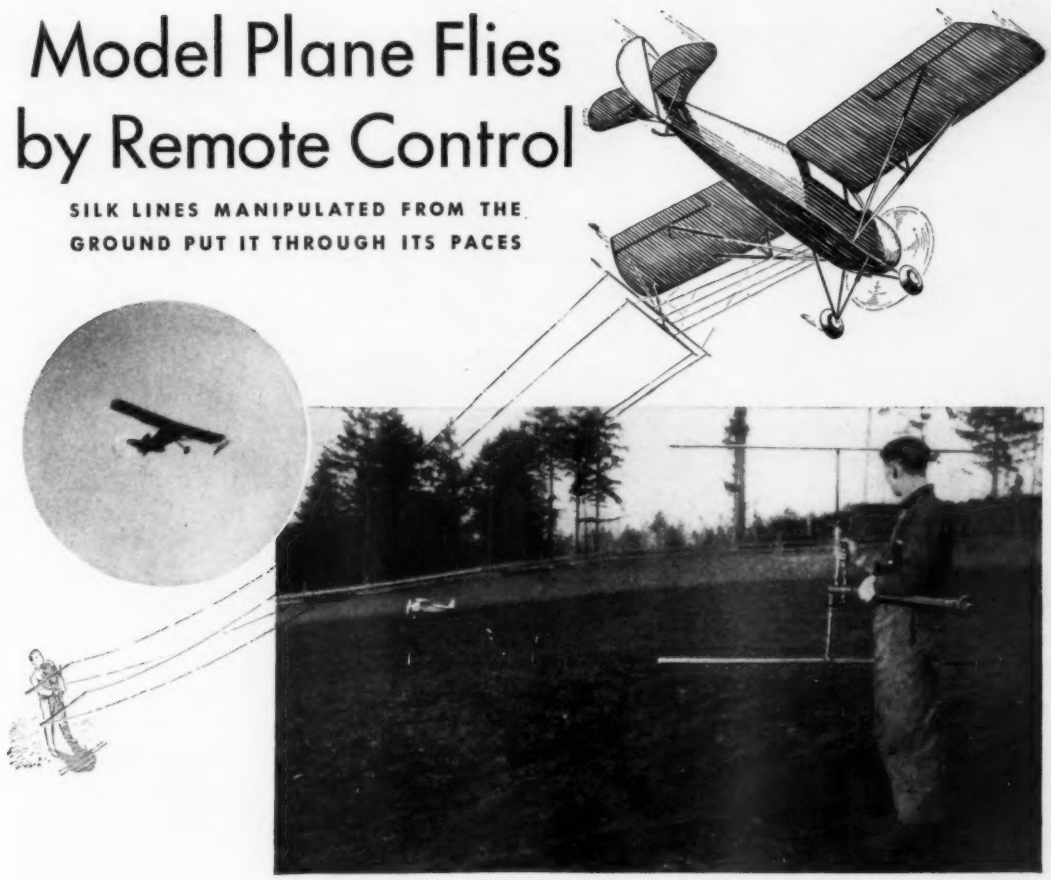
A last word, and particularly addressed to beginners and very amateur snake enthusiasts.

While snake venom is harmless taken internally by mouth, *if all is well*, it's a pious idea *not* to give an exhibition of bravado by swallowing some of it. All you need is a sore place in the mouth, throat, or innards farther down, which you may not realize you have, and you can be a mighty sick person and not much can be done to help you either. So just as well not try it. And besides, it doesn't taste very good, anyhow.

Another thing. Don't breathe venom vapor, or get venom in your eyes, or in a cut, or on an abrasion. You'll be sorry if you do. In short, it's a substance to be handled with care if you handle it at all.

Model Plane Flies by Remote Control

SILK LINES MANIPULATED FROM THE GROUND PUT IT THROUGH ITS PACES



Just before a take-off. O. L. St. Clair at the controls. Inset shows plane in flight

TAKING OFF under its own power, flying, stunting, and landing again at the will of its "pilot" on the ground, a small gasoline-motored model plane built by O. L. St. Clair, of Yamhill, Ore., is said to be the first of its type to be remotely controlled—otherwise than by radio—in flight. While the midget ship must fly in a circle, it can zoom, glide, dive, and perform many other aerial maneuvers. An arrangement of strings connected to the plane's controls is led from the cabin to a pair of levers pivoted on a vertical strut below one wing. Four strong silk lines, or bridles, fifty feet long, are attached to the ends of the levers and run out to a miniature control stick held by the operator on the ground. The strings not only convey the movement of the operator's control stick to the plane, but through an ingenious arrangement they also can speed up or throttle down the miniature motor. Stationed at the center of the field, the operator works the controls to gun the motor and make the plane take off. During the flight, he turns slowly to keep the ship in front of him as he puts it through its paces. St. Clair has estimated that the plane is capable of flying more than 500 miles at cruising speed on a single gallon of gasoline.

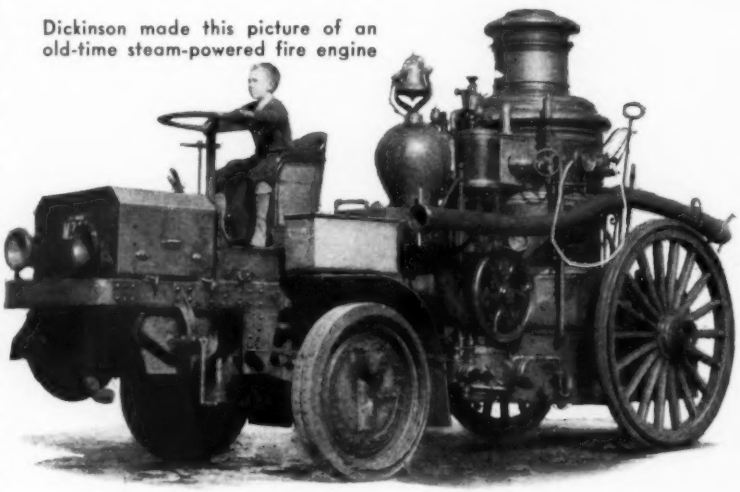
How the control lines are rigged under the wing of the gas-powered model

Photographs Fires from a Wheel Chair

WITH a fire siren on his wheel chair, David T. Dickinson, former fire-insurance expert of Cambridge, Mass., who is an infantile-paralysis victim, follows a lifelong hobby of photographing fire fighters at work. His three-wheeled, motorized chair is a familiar sight to smoke eaters in Boston and vicinity. All told, Dickinson has responded to more than 1,000 alarms, snapping pictures of the fires and the work of battling the flames.

His hobby began thirty-two years ago, when he was a boy of thirteen and owned a box camera. In 1924, when he was stricken with infantile paralysis, the chances of continuing his strenuous avocation seemed ended. But, as soon as he was able, Dickinson purchased the motor-driven chair, equipped it with a siren and spotlight, and, carrying his camera on his lap, began answering alarms as before.

To keep track of big fires, he has two short-wave radio receivers in his home. One is tuned in on the police frequency; the other on

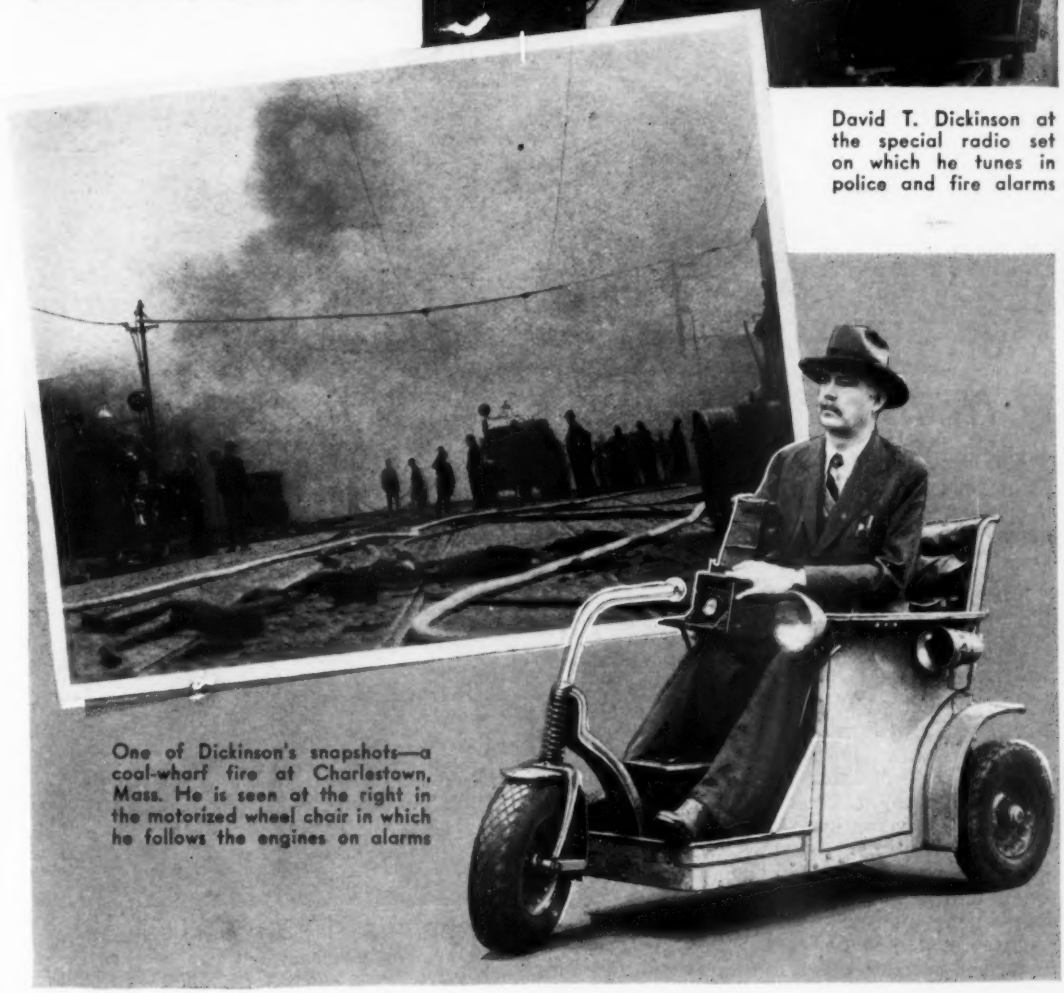


Dickinson made this picture of an old-time steam-powered fire engine

that of the fire department. As soon as word of an important blaze flashes out over the air waves, Dickinson loads his 3¼ by 4¼-inch camera into his wheel chair and heads away in the direction of the fire. Many of these runs are made late at night. When photographing is possible, he maneuvers his odd vehicle into position for the best shots. Later, in a special darkroom in his home, he develops the negatives and prints the pictures to add to his collection.

Many of these photographs have historical significance. For example, a quarter of a century ago, Dickinson spent one winter snapping pictures of all the horse-drawn steam fire engines in and around Boston. More than sixty pictures resulted from this activity. The hugest of these early engines was "Abe Lincoln," built in 1883 and belonging to the Boston Fire Department. This machine, later motorized, was claimed to be the most powerful fire engine in use anywhere in its day.

David T. Dickinson at the special radio set on which he tunes in police and fire alarms



One of Dickinson's snapshots—a coal-wharf fire at Charlestown, Mass. He is seen at the right in the motorized wheel chair in which he follows the engines on alarms

Mural in Water Color Forms Mammoth Map

SAID to be the largest water-color painting in the world, a gigantic mural recently completed for exhibition at the New York World's Fair depicts an airplane view of New York City with the fidelity of a map and at the same time with the brilliance of a stained-glass window. The work of Carl Roters, of Stevens Institute of Technology, Hoboken, N. J., the mammoth mural spans a wall surface more than seventeen feet high and fifty-four feet long. Painted in 114 separate sections, each nine square feet in area, with brushes twenty times as long as those in common use by water-color artists, the picture was assembled in checkerboard fashion when painting was completed. A newly developed color-fixing varnish will give the mammoth mural a permanence not usually found in water-color work. The mural will supplement another record project—a huge architectural model of New York City, said to be the world's largest diorama.

Carl Roters assembling sections of his huge water-color painting showing a bird's-eye view of New York City. Above, painting one of the 114 sections

Improved Drive-in Bank Window

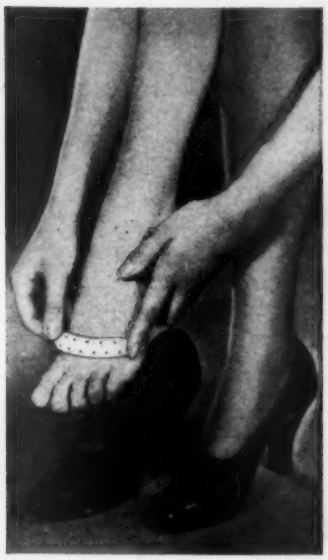
AT THE drive-in window of a Texas bank, where motorists can transact business without leaving their cars, customers place deposits or checks in a revolving steel drawer. By turning the device, the teller brings the drawer inside his cage. Bars and bulletproof glass guard the cage.

Braces hooked over the handlebars support the baby carriage

At the left, the pram is being used in the conventional way

Adhesive Pads Cushion Pumps

WOMEN'S shoes that fit tightly and cut across the instep can now be worn in comfort when a new rubber pad is used. Fastened by its adhesive backing to the foot, as shown below, the pad is faced with flesh-colored silk to make it inconspicuous where it extends beyond the shoe.



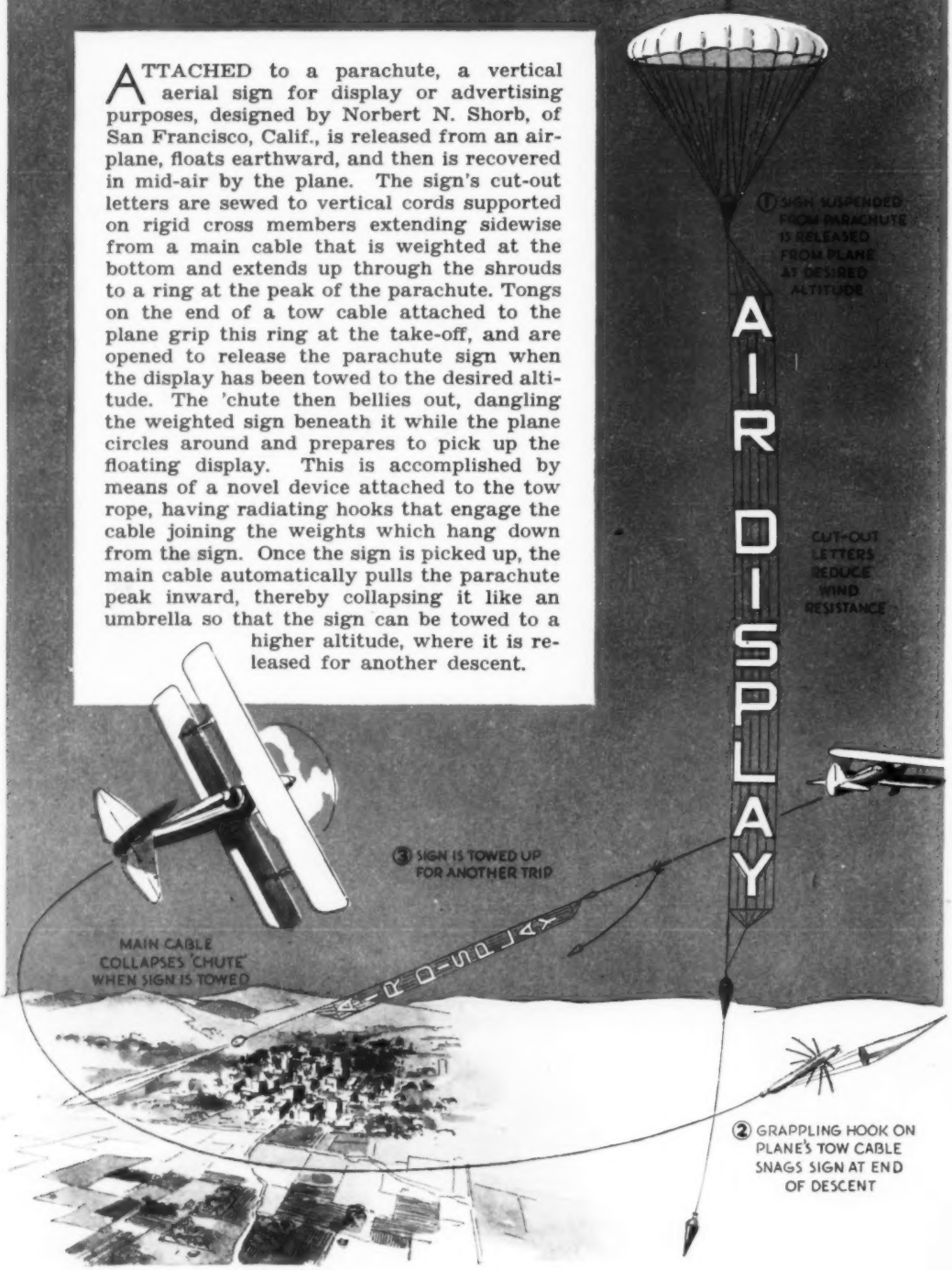
Faced with silk, the pads are not visible underneath the stockings

Baby Carriage Rides Bicycle

A NOVEL baby carriage that can be pushed along the ground or mounted on a bicycle while giving the infant an airing, is the invention of a Copenhagen, Denmark, parent. Light in weight, the pram is designed to rest securely on metal braces that hook over the bicycle handlebars and support the carriage from beneath. A canvas windshield can be drawn up to protect the child from too much air, while the carriage handle is pivoted so that it can be swung forward out of the way of the cyclist, as shown at the left.

Plane Retrieves Aerial Sign

ATTACHED to a parachute, a vertical aerial sign for display or advertising purposes, designed by Norbert N. Shorb, of San Francisco, Calif., is released from an airplane, floats earthward, and then is recovered in mid-air by the plane. The sign's cut-out letters are sewed to vertical cords supported on rigid cross members extending sidewise from a main cable that is weighted at the bottom and extends up through the shrouds to a ring at the peak of the parachute. Tongs on the end of a tow cable attached to the plane grip this ring at the take-off, and are opened to release the parachute sign when the display has been towed to the desired altitude. The 'chute then bellies out, dangling the weighted sign beneath it while the plane circles around and prepares to pick up the floating display. This is accomplished by means of a novel device attached to the tow rope, having radiating hooks that engage the cable joining the weights which hang down from the sign. Once the sign is picked up, the main cable automatically pulls the parachute peak inward, thereby collapsing it like an umbrella so that the sign can be towed to a higher altitude, where it is released for another descent.


① SIGN SUSPENDED FROM PARACHUTE IS RELEASED FROM PLANE AT DESIRED ALTITUDE
AIR DISPLAY
CUT-OUT LETTERS REDUCE WIND RESISTANCE
③ SIGN IS TOWED UP FOR ANOTHER TRIP
MAIN CABLE COLLAPSES 'CHUTE WHEN SIGN IS TOWED
② GRAPPLING HOOK ON PLANE'S TOW CABLE SNAGS SIGN AT END OF DESCENT

Weird Masks Shield Faces of Climbers

WHAT the well-dressed mountain climber wears to protect his face from howling gales and driving snows as he labors up toward a peak in winter weather is pictured in the photograph at the right, showing a Colorado Pikes Peak climber swathed in a leather helmet, glareproof goggles, and a white leather face mask open only at the nostrils. The mouth strip comes off.

Freezing mountain winds can't get at the face of this Pikes Peak climber

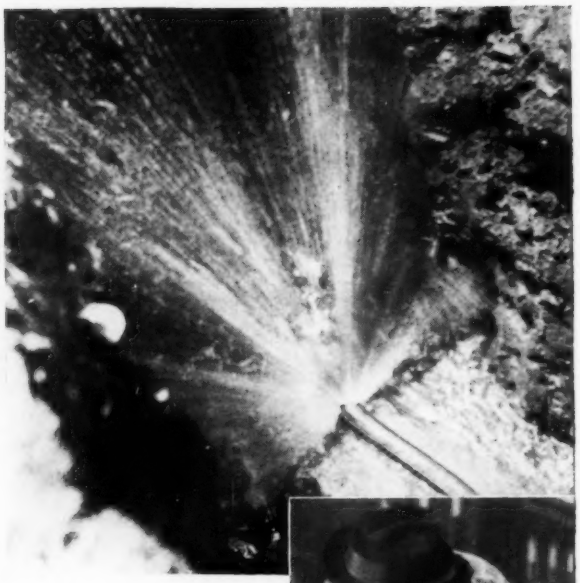
Cabbage Juice for Diabetes

JUICE of the humble cabbage may replace injections of insulin for the treatment of diabetes, according to a report by two English scientists. The cabbage extract is said to aid the body in using sugar, which is what insulin does when injected into persons suffering from diabetes.

Firemen Numbered Like Football Players

Numbers on the backs of firemen's coats identify them to their officers

IDENTIFICATION numbers, like those on the jerseys of football players, are now being worn on the waterproof coats of Orange, N. J., firemen. According to Fire Chief George Gmeiner, the numerals are not intended for the convenience of bystanders who want to cheer for a favorite smoke-eater, but for easier identification of individual firemen by officials directing fire-fighting work. "When giving orders, it's hard to recognize individual firemen on ladders," he says.



Underground leaks like this are spotted by use of the aquaphone, seen in action in the picture at the left

Applied to a fire hydrant, a small listening instrument can detect sounds of running water

Water Detectives Locate Leaks in City Supply Lines

BILLIONS of gallons of water, valued at more than $1,000,000, are being saved yearly in New York City by a corps of 500 men who conduct a continuous underground search for leaks in the water mains and supply pipes that honeycomb the city's foundations. Equipped with special instruments for detecting and locating leaks, workers enter a cellar, turn off the house water supply to eliminate water noises in the building, and then listen in on supply pipes with a simple sound detector consisting of a metal rod and an earpiece. If a leak is heard, a location squad is called. Using an aquaphone, a delicate instrument resembling a doctor's stethoscope, they determine the exact spot where water is seeping out of a pipe or through a joint. When the course of buried pipes is difficult for repairmen to trace, a geophone, which creates a magnetic field to force hidden metal pipes to reveal their exact location, is brought into play. In addition to the 500 leak finders in the field, 450 draftsmen and seventy-five engineering surveyors are preparing a complete underground map of New York City to show the positions of meters, water and gas pipes, telephone cables, tunnels, and other utility features.

Tracing a buried pipe with the geophone. A magnetic field reveals the metal under the ground

At Last—a Rose That Has No Thorn

COMING to this country as an immigrant in his teens, Nicolas Grillo, Connecticut gardener, recently climaxed his career as an expert rose grower by developing a thornless rose, a feat that floriculturists have dreamed of for centuries. Discovered by accident about a year ago, the unique rose is now cultivated by grafting shoots of the thornless variety to Manetti, a sturdy root stock. The grafts are placed in air-tight, heated incubators for six weeks, and then transferred to the soil of a greenhouse bench to mature.

Nicolas Grillo displaying a specimen of the thornless rose he developed. In the photograph at the left, the rose is seen in five stages of bloom, from the bud to the full-blown flower

Make-Up Mirror Lights Face

WOMEN can apply make-up in theaters, motion-picture houses, and other dimly lighted places with a novel illuminated pocket mirror now available. The mirror is hinged to a tiny flashlight which illuminates the face of the user, as pictured in the photograph above.

Toy Trains Haul Targets for Soldiers

TOY electric trains are helping British Army recruits to perfect their marksmanship. Cardboard targets are mounted on wires attached to the cars of a miniature train, which rolls along a track in front of a firing wall to provide moving targets for rifle practice. An officer at the controls can slow down or speed up the train to provide variations in the movement of the targets.

Targets are mounted on wires above the cars of the toy electric train

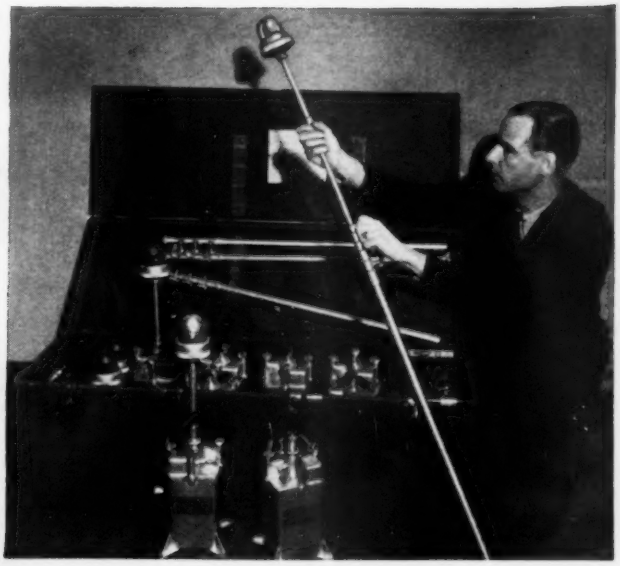
Huge Cockpit Is "Bridge" of Giant Plane

At this big panel, the flight engineer controls the motors. The door at right leads to a motor-inspection passageway

A view of the spacious cockpit, showing the stations of the first pilot, second pilot, and the radio operator

FIFTEEN times as large as the cockpit of a modern twin-motor transport, the huge control room pictured on this page is the nerve center of a seventy-four-passenger clipper plane, one of a fleet of six being constructed at Seattle, Wash., for transoceanic service. In the photograph at the left, four of the six stations within the spacious cockpit are visible: the chief pilot's, the second pilot's, the navigator's, and the radio operator's. The ship's captain has a desk at the left rear of the cockpit, while the right rear section is occupied by the flight engineer, shown above controlling the operations of the four 1,500-horsepower motors.

The revolving beacon below is part of the portable landing-field lighting system. At right, extending pole of obstruction marker



Portable Lighting System for Emergency Airports

COMPACTLY nested into four metal trunks that can be stowed in the baggage compartment of an airplane, a novel 600-pound, portable lighting system can be set up by one man within fifteen minutes, to turn any level stretch of ground into a lighted emergency airport. The outfit, useful also when power failures darken established airports, includes a two-light revolving beacon, a 250-watt, gasoline-driven generator, red, white, and blue field lights, and obstruction marker lights mounted on ten-foot poles.

Student Sleeps at This "Night School"

ALTHOUGH sleeping through lecture courses has never been recommended to students, Elmer H. Brown, of San Francisco, Calif., says it is just the thing if you use one of his "subconscious educator" machines. Consisting of an electric phonograph controlled by a time clock, the outfit is wired to headphones incased in a helmet which the student dons just before going to bed. The phonograph then reproduces recorded lectures, which, according to Brown, are absorbed by the subconscious mind of the scholar during the time he is sleeping.

Elmer H. Brown trying out his device for studying while you sleep

Junk-Car Derby

GARAGE MEN TEST THEIR SKILL AS MECHANICS AND DESIGNERS IN THRILLING PUDDLE-JUMPING RACES

Puddle jumpers lined up for the start of a race in the "Mud Bowl" near Tulsa, Okla. At the left, a winner has the mud scraped from his face as a preliminary to receiving a cup

ROARING around a half-mile circle of mud, dust, puddles, and ruts in a Tulsa, Okla., cow pasture, garage mechanics race cars rebuilt from the junk heap in a mud derby that is one of the queerest sporting spectacles in the world. Competing in ten and twenty-five-mile feature events for money prizes, silver cups, the publicity they get from ads painted on their cars, and to test their skill as mechanics and designers, these dare-devil drivers throw caution to the winds as they gun their puddle jumpers along a race track that is everything a race track should *not* be.

On a Sunday afternoon, thousands of thrill-hungry spectators pay a quarter apiece to

By PAUL A. CLARKSON

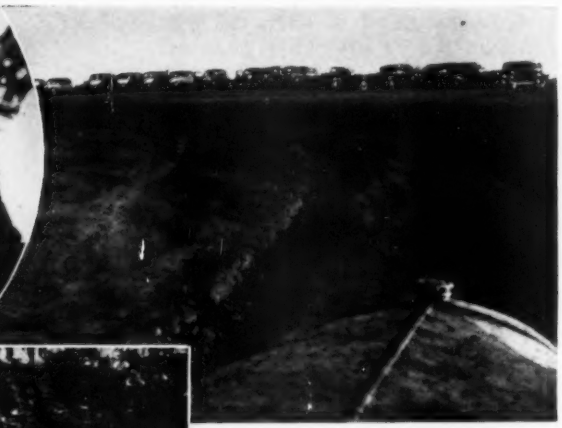
line the mudway on the outskirts of Tulsa. They come early to watch trial runs in which drivers must plow through the half mile of mud and dust in fifty seconds to qualify for the main events. They gaze approvingly at the preliminary damage done by a heavy watering truck that cuts new ruts into the course as it wets down the straightaways and dumps more water into a huge race-track mud hole to give it the proper oozy consistency.

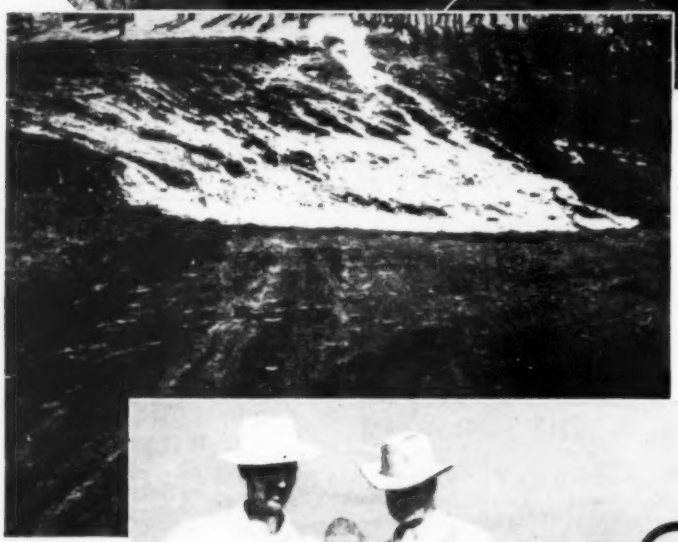
At the starting post, a score or more of patchwork buggies line up—Model A Fords, an occasional eight-cylinder job, rebuilt taxis, and various other types that have been lovingly tuned to maximum efficiency and then stripped down to the bare essentials of motor, chassis, and racing body. When a new driver turns up with a car that can still boast of anything as fancy as a fender, old-timers do their best to jam it off during the first few laps of the race.

Many of these cars, rattletrap as they look, are highly efficient motor vehicles, embodying new ideas and inventions of the garage men who design, build, own, and drive them. Some have special speed gears, others employ high-ratio differentials, special valve systems, trick springs, or home-built carbu-

A mechanic makes a last-minute inspection of a motor before sending his car out on the track. Below, two racers are slithering into the man-made mud hole that forms one of the major obstacles of the track. Note the cloud of dust hovering in the background

The picture at the left shows what a driver's face looks like after a few laps of alternating dust and mire. Below is a snapshot made from one of the cars as it swung into a flat curve from the back stretch





Left, what a driver sees of the mud hole—before he closes his eyes for the plunge. A water truck prepares the goo before each big event

A typical entry is seen below. They are all stripped down to the bare essentials for running

retors. Whatever the innovation, it is certain to get the most strenuous of test trials.

Hop into one of these bounding, fifty-mile-an-hour advertising signs and take an imaginary whirl around this nightmare mud bowl. Roaring past the judges' stand, you pick up speed on a 100-yard straightaway ending in a left turn that catapults your jallopy down a grade that seems as steep as a canyon wall. Once you hit bottom, you're in a mud quagmire. Wiping the black ooze from your eyes, you nudge the groaning puddle-jumper uphill into a left turn that is as slippery as a greased griddle.

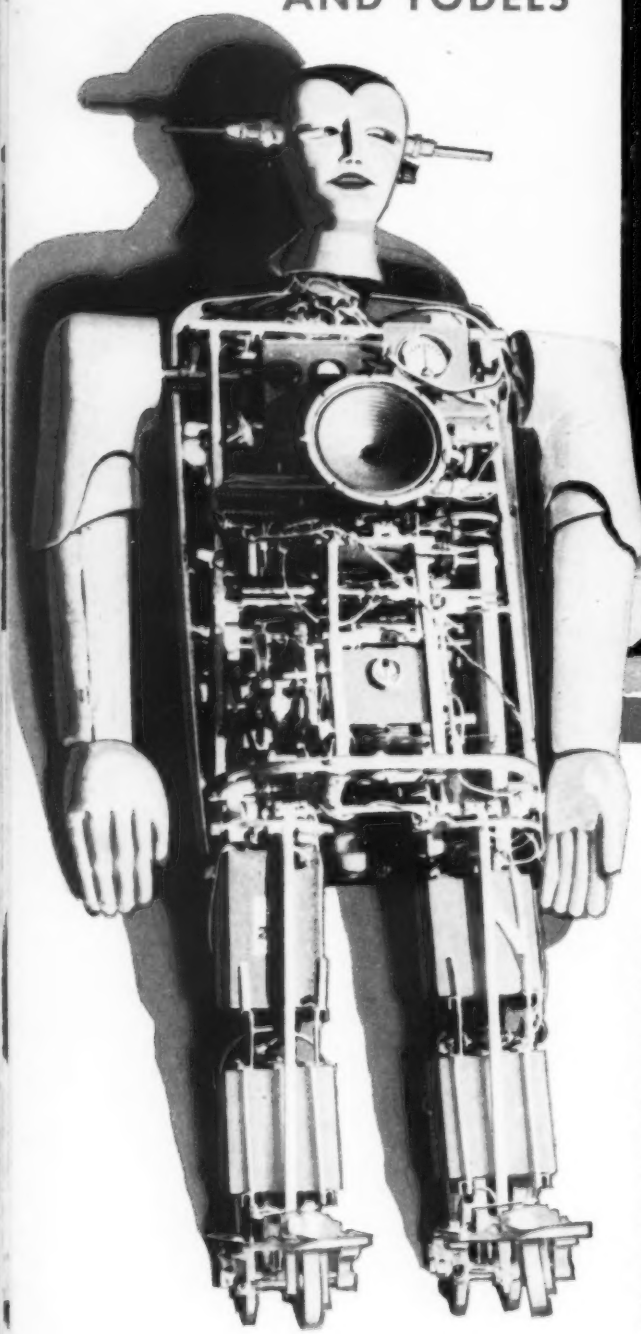
If you are still with the car, you spin around a right-left S curve and are rewarded by easy sailing down a back stretch broken only by ruts, sink holes, loose dirt, hummocks of earth, and other minor inconveniences. Hissing out the breath you have been holding since the starting gun, you inhale a mixture of air and dust while slithering around a flat, rut-scarred curve that slides the car into the home stretch for a bumpy trip back down to the starting line. Repeat that nineteen times, and you've run a complete race. The fifty-lap grind comes later.

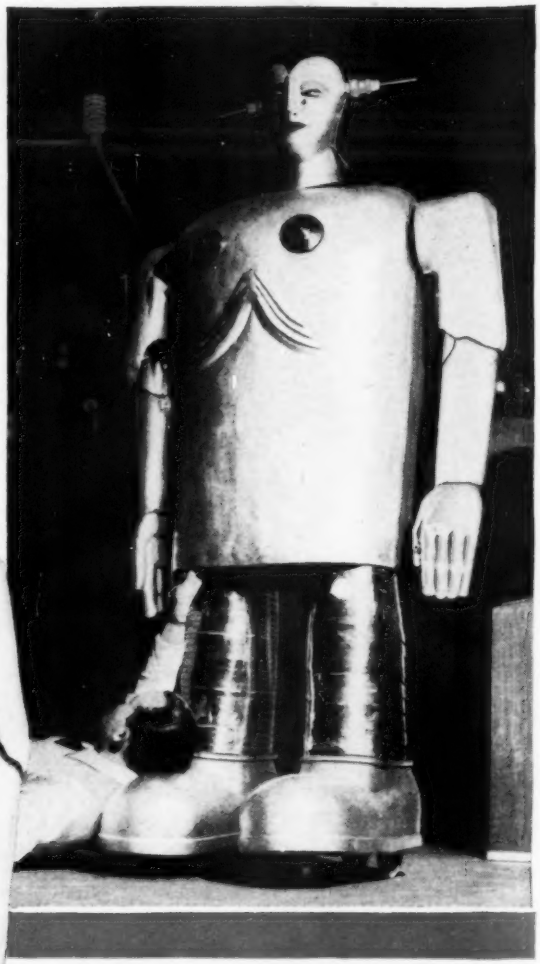
Advertisements are displayed prominently on some cars, which are sponsored by local firms as a method of getting publicity

Miraculously, no driver has yet been injured seriously during this mud-lark on wheels, even though there is an average of two complete car turnovers in each race. That record speaks well not only for the driving skill of these fearless mechanics but also for their ability in rebuilding worn-out jallopies. For the motto of these mud-derby mechanics is: When better cars are rebuilt, we'll rebuild them.

A driver hits the mud hole with a splash. Thousands of spectators line the track for Sunday-afternoon races

"Radio Man"
WALKS, TALKS, AND YODELS





August Huber putting finishing touches on his "radio man." At left, covering is removed to show the intricate mechanism

TOWERING seven feet high, a strange "radio man" has just been completed after ten years of arduous work by August Huber, a Swiss engineer. Beneath its jointed steel body, the gigantic mechanical man is a maze of automatic switches, relays, and other controls. Microphones within the automaton's ears pick up spoken commands and carry them to an intricate system of twenty electric motors that make the fantastic creature walk, talk, sing, or yodel at the will of its master. Power for these various activities is supplied by batteries concealed in the ponderous legs. When this modern monster talks through the loudspeaker installed in its chest, its lips move in time with its speech. An ultra-short-wave receiver installed in its torso enables the "radio man" to follow orders transmitted to it by radio from remote points.

Fish can't make off with his bait. It's a wooden decoy on a pole

African Native Uses Decoy To Lure Fish

ANGLERS who have had little success in landing fish might take a tip from the African native pictured at the left. He uses a hand-carved wooden fish fastened to the end of a long stick as a lure to attract real fish within range. The native wiggles the stick with his foot to give the decoy a swimming motion, while he keeps a native fishing spear poised ready to strike when the unwary game, deceived by the realistic appearance of the dummy, swims within his range.

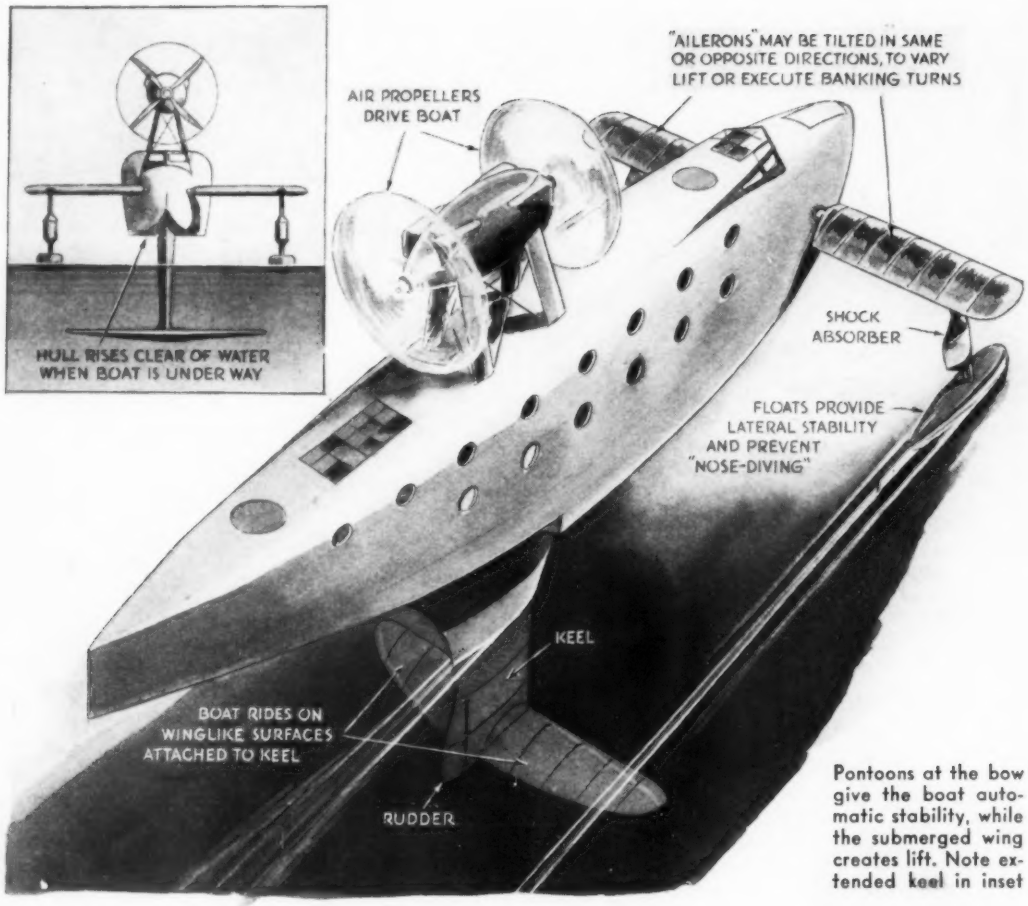
Plane To Gauge Speed of Radio

TESTS to determine whether radio waves travel faster from east to west than from west to east are the purpose of an airplane flight being planned. A plane traveling 200 miles an hour will fly 700 miles west from Washington, D. C., and return, nonstop, as it records Washington time signals and sends its own signals back to Washington for recording, throughout the trip.

Small Hand Tool Removes Dents in Car Bodies

DENTED fenders and other damaged parts of an automobile body are easily pressed back into shape with an inexpensive tool now available. The device consists of an adjustable hook that is worked back and forth to iron out the damaged pa . Rub r suction-cup feet prevent slipping and protect the car finish. The tool is shown in use on a car window frame, in the photograph at the right.

Two suction-cup feet protect the finish and prevent slipping


"AILERONS" MAY BE TILTED IN SAME OR OPPOSITE DIRECTIONS, TO VARY LIFT OR EXECUTE BANKING TURNS
AIR PROPELLERS DRIVE BOAT
HULL RISES CLEAR OF WATER WHEN BOAT IS UNDER WAY
SHOCK ABSORBER
FLOATS PROVIDE LATERAL STABILITY AND PREVENT "NOSE-DIVING"
KEEL
BOAT RIDES ON WINGLIKE SURFACES ATTACHED TO KEEL
RUDDER

Pontoons at the bow give the boat automatic stability, while the submerged wing creates lift. Note extended keel in inset

Boat Rides on Underwater Wing

NOVEL PLANELIKE CRAFT SKIMS OVER THE WAVES

SKIMMING along the water at high speeds, with its hull entirely clear of the surface, a curious, airplane-type speedboat designed by a French inventor, Wsevolode Grunberg, of Paris, is supported by a specially designed central keel, supplemented by two forward pontoon floats. Plans for the novel water craft call for a hull that resembles the port-hole-studded fuselage of a giant transport plane, surmounted by a strut-supported engine whirling twin propellers, one facing toward the bow and the other toward the stern, to furnish both a pushing and a pulling force. The majority of the craft's weight is supported by a horizontal wing-shaped surface extending out at either side of the rudder, near the base of the keel. Lateral stability of the craft is obtained by the bow pontoon floats, which are connected through shock absorbers to adjustable horizontal members in the form of ailerons jutting out from the prow of the ship. The weight of the vessel, the inventor explains, is so distributed that the ship always has a tendency to nose-dive, or tip forward, the pontoon floats automatically keeping the craft on an even keel, since the farther they are pushed down into the water, the greater their lifting force. Thus, if a wave should cause the ship to lurch forward on its nose, the supporting force of the floats would instantly increase, while that of the horizontal section of the keel would decrease, due to the tipping action. This automatic change of forces would therefore bring the boat back to its normal position, it is claimed. The inventor points out that it would be possible to use the floats as reservoirs for fuel if desired.

Traveling Ice Box for Refrigerated Express Service

Frozen foods and other perishables can be shipped in this insulated, refrigerated container

REFRIGERATED express service, for shipping packages of quick-frozen foods and other perishables, is provided by a new container of special design. The trunk-size, heavily insulated "ice box" rolls on six casters as shown at the right, and one man can easily handle it fully loaded on a level floor.

Student comparing a drawing with oversize clock model

Giant Clock Parts Show What Makes It Tick

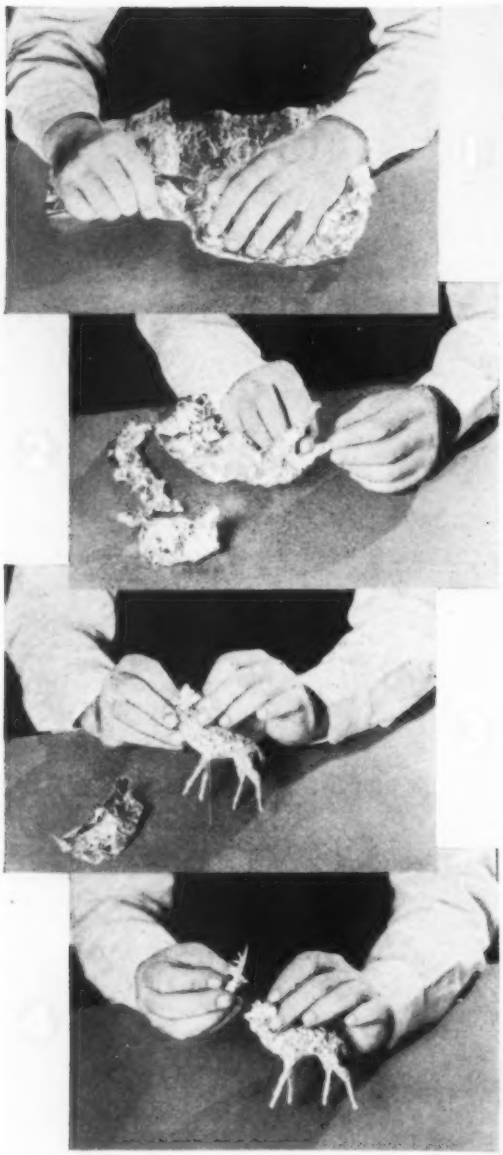
GIANT working models of clockwork escapements, and other parts of watches and clocks, help students to familiarize themselves with "the works" at the Philadelphia College of Horology. By comparing blueprints of parts with models that may be as much as fifty times enlarged, the pupil sees at a glance what makes a timepiece tick. In other classes the students learn the delicate art of cutting gear wheels and assembling the tiny, complicated works of watches.

Plastic Picture Hangers

MADE of unbreakable plastic, wall-type picture hangers of new design can be driven home without danger of shattering them. The gayly colored hooks, illustrated about one and a half times actual size, hold ten pounds apiece and are supported by rustproof, cadmium-plated nails.

TIN-FOIL SCULPTURE

How One Man Makes Good Use of a Common Wrapping Material That Most of Us Throw Away



Step by step in the tin-foil sculpture. 1. Three pieces are torn to required size. 2. Skillful fingers form body and head. 3. Legs in place and parts crimped together. 4. Antlers added. 5. In five minutes a graceful deer is fashioned

THIRTY years ago, as a child, Paul E. Tichon began collecting scraps of tin foil. He still does. In the meantime, every scrap he could lay his hands on he has converted into hundreds of delicately hand-wrought pieces of "sculpture," some of which are illustrated on these pages.

Zebras, strange birds, dogs, deer, gayly bedecked knights in shining armor astride well-modeled horses, and dozens of other creatures line shelves in his Akron, Ohio, home, while one of his most prized creations is a framed three-dimensional picture in tin-foil relief showing a wintry woodland scene with fawns grazing in the foreground.

A lifelong fondness for studying animals and a natural artistic aptitude combined to give Tichon his remarkable skill in modeling. Unlike sculptors who use tools, he forms his figures entirely by pressing the metal foil into desired shapes with his fingers. Metal foil has certain advantages other modeling mediums lack, according to

This elaborate knight in armor is painted to give a realistic touch

Tichon. It is yielding enough to be pressed into shape, yet it does not spring out of shape when pressure is removed. And, as it crinkles under pressure, it becomes stronger just as corrugated metal is stronger than sheet metal.

A capable artist familiar with painting in oils, Tichon quite naturally tried combining his two talents. The result was more than satisfactory. Now he hand-paints his zebras, for example, in true-to-life colors and patterns which, as he jokingly puts it, enable people to distinguish his zebras from his jackasses. Paint solved another perplexing problem for him—the obtaining of lifelike faces. Details of eyes, nostrils, and other features applied with artists' oil colors did the trick.

Tichon's animals are usually made of only two or three pieces of foil which he first cuts to approximate sizes. They are pressed, modeled, bent, and folded to form the figures, then crimped together. So agile are his fingers that he can model a deer in less than five minutes. He has trained himself so thoroughly that he can make from memory in a surprisingly short time a realistic tin-foil figure of almost any species of bird or beast you can mention to him.

Paul E. Tichon and a group of his odd, tin-foil figures. His knowledge of animals enables him to make many from memory

Three-dimensional picture made of interlocking pieces of foil and then painted

Talking Card Says "Happy Birthday"

A TALKING birthday card is an ingenious novelty now on the market. Extending from the mouth of a picture of Charlie McCarthy, famous ventriloquist's dummy, printed on the card, is a notched sound tape. When a person pulls his thumb nail along the tape, as shown above, the words "Happy Birthday" are clearly reproduced.

Shield Guards Worker's Eyes

TO PROTECT his eyes from sawdust and flying chips, a Washington State lumber worker sewed an oblong sheet of celluloid to his hat brim. Since the brim holds it away from his face, the celluloid shield does not cloud up from condensed breath.

Dog Rings Bell for Service on Canine Elevator

NO ONE has to make a special trip downstairs to open the front door when Buttons, an educated dog belonging to a mechanically minded Californian wants to come into the house. The trained pooch merely bangs a paw on a bell to signal for a novel dog elevator, rigged up by his master on the outside of the dwelling. The canine lift consists of a packing box that is raised and lowered by hand power from a second-story window, as pictured above.

This is how Buttons calls for his private elevator. In the picture above, he is returning from a romp

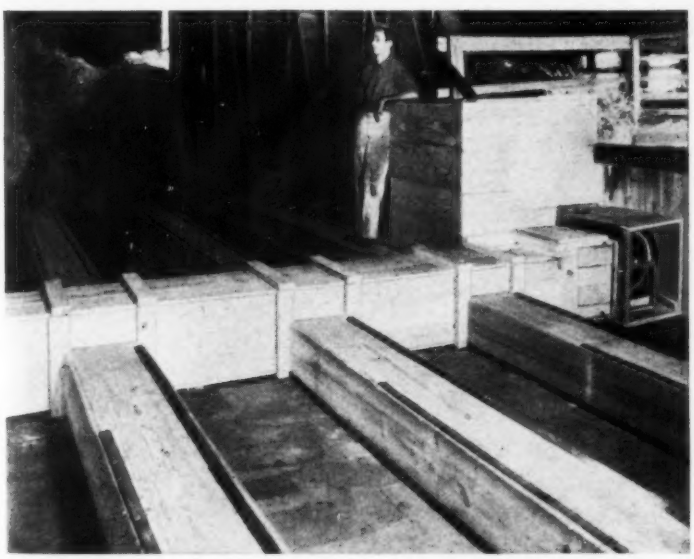
Three-Wheeled Midget Car Has Engine at the Rear

HARDLY larger than a child's toy, a midget automobile now on the market is powered by a 1½-horsepower, four-cycle engine of special design geared to a single rear driving wheel. Front wheels are set far enough apart to give stability to the narrow body. The motor is placed behind the leather-upholstered driver's seat to allow plenty of leg room beneath the hood. Small as it is, the car boasts of many advanced features, including individual wheel suspension, an all-steel body, and a shockproof steering wheel. A simple synchronized clutch and brake pedal give the driver perfect control. The tiny automobile is also available with a heavy steel bumper for use in midget-car racing.

With its 1½-horsepower motor mounted behind the driver's seat, this tiny auto has ample leg room

Electric Drier Saves Hay Crops

HEAVY rains can no longer ruin a farmer's hay crop if he uses a novel electric hay drier pictured below in use in the barn on the experimental farm of the University of Tennessee, at Knoxville. Wet hay fed into a hopper is blown through heated air in long wooden ducts to emerge completely dry and ready for storage in the loft.



Hay driven through wooden ducts by warm air is dried out for storage

Magnetic Lamp Lock Foils Bulb Thieves

ELECTRIC-LIGHT bulbs are locked into place in a novel plastic socket attachment now available. A bulb can be screwed into, or removed from, a loose metal holder within the attachment only when a powerful magnet is used to keep the holder from turning freely, as shown above.

NEW WRINKLES

Used as shown above, the strap forms a "cross brace" to steady the camera

Carrying Strap Braces Camera

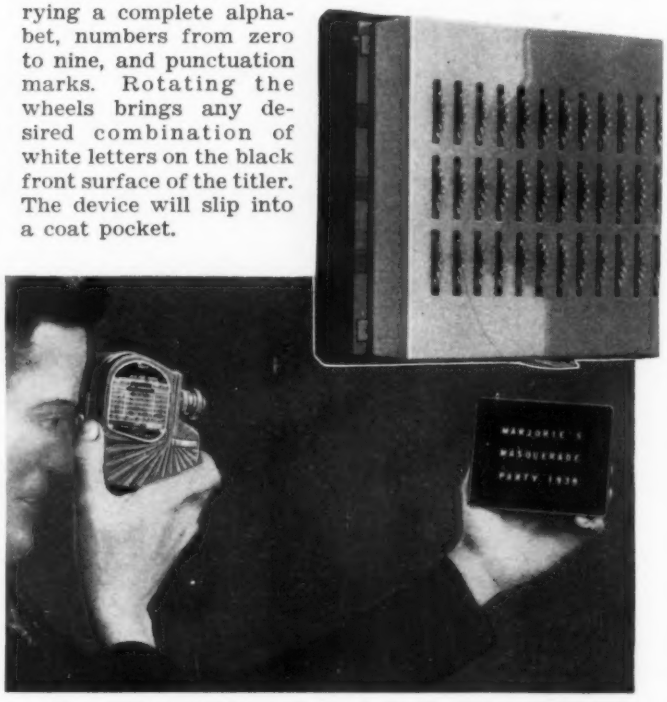
DESIGNED to aid amateurs in holding miniature cameras steady while making slow snapshots, a new wrist strap also provides a convenient means of carrying the camera between exposures. A screw on one end is fitted into the tripod socket on the camera. When taking pictures, the leather loop is slipped on one of the wrists and pulled taut. In this position, it serves as a "cross brace" between the two hands, holding the camera rigidly.

Film Tray Lowers Developing Cost

LESS developing solution is required, according to the manufacturer, when used in a new roller-equipped developing tray. The film is run under the roller, emulsion side down, and then seesawed back and forth, with the roller preventing the film from being lifted out of the developer during the process. Thus, all parts of the strip receive even development. The trays take roll film three and a quarter inches wide.

Movie Titler Is Automatic

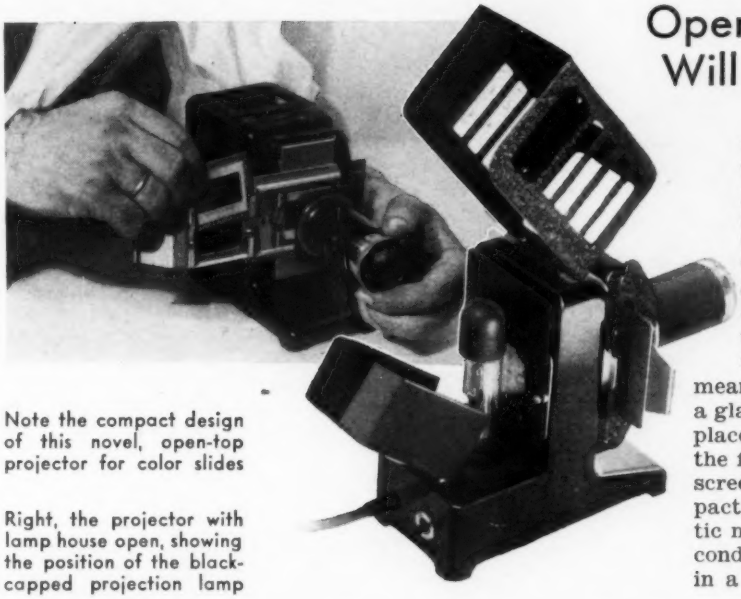
THIRTY-SIX notched wheels at the back of a new device eliminate the labor of setting up individual letters and numbers when making home-movie titles. Each wheel operates a continuous ribbon carrying a complete alphabet, numbers from zero to nine, and punctuation marks. Rotating the wheels brings any desired combination of white letters on the black front surface of the titler. The device will slip into a coat pocket.



Twirling notched wheels on the back of the titler sets up lettering that can be photographed directly with a movie camera

FOR CAMERA FANS

Open-Top Projector Will Not Overheat

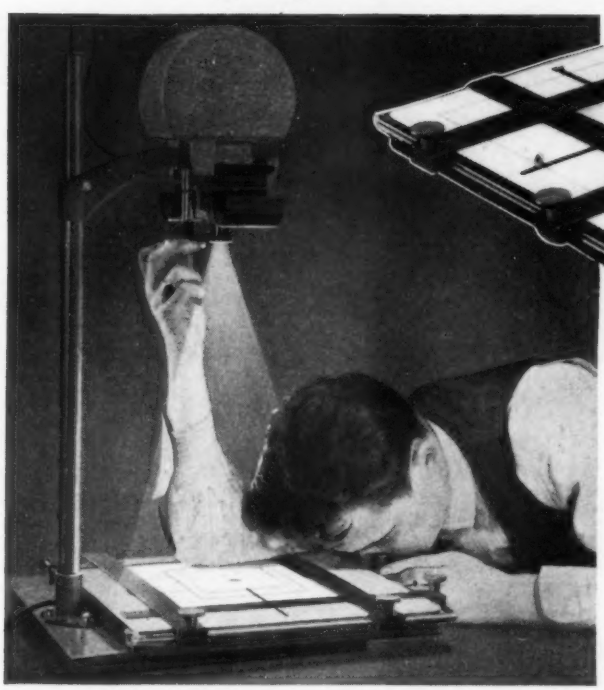


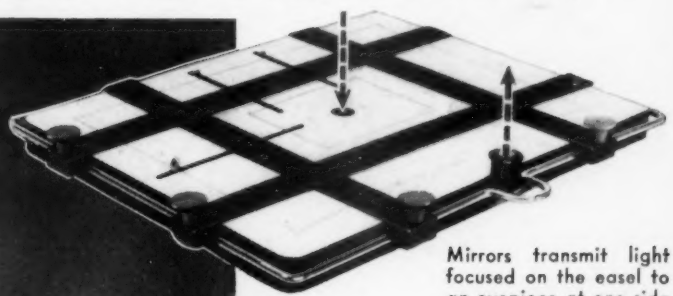
Note the compact design of this novel, open-top projector for color slides

Right, the projector with lamp house open, showing the position of the black-capped projection lamp

BY PAINTING the top of the projection lamp black, the designers of a new projector for miniature color slides have been able to use an open-top housing which provides unusual cooling facilities. The black cap on the lamp reduces the leakage of light through the opening. As a further means of dissipating the heat, a glass heat-absorption filter is placed between the lamp and the film being projected on the screen. The base of the compact projector is made of plastic material and the three-lens condensing system is secured in a semicircular mount.

Enlarging Easel Has Built-In Focuser



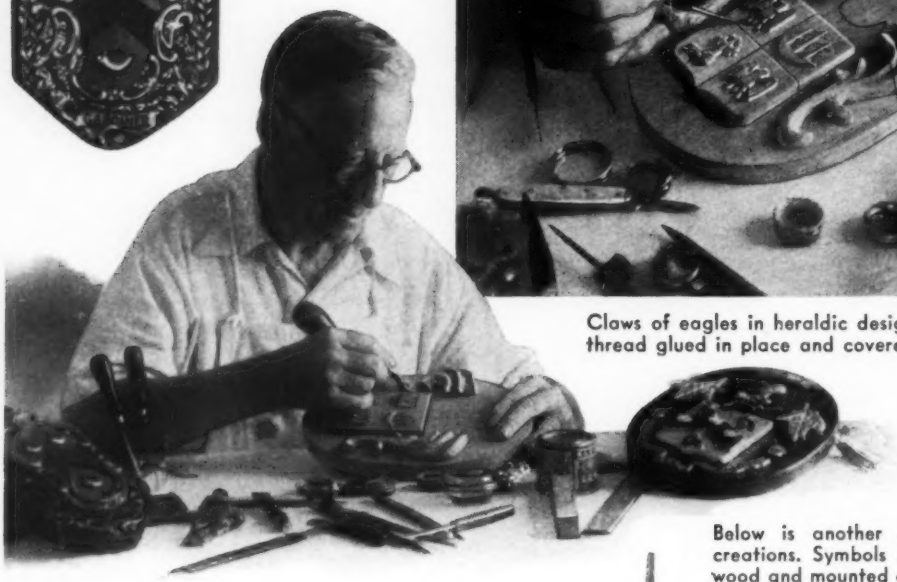


Mirrors transmit light focused on the easel to an eyepiece at one side

Peering into an eyepiece, the user sees part of the negative magnified to fifteen times the magnification of the enlarger

MAGNIFYING a small portion of the image fifteen times as much as the magnification of the enlarger, a focusing device built into a new easel simplifies the work of getting perfectly focused enlargements from miniature negatives. The operator peers through an eyepiece at the edge of the easel as he adjusts the enlarger to bring the image into focus. When he sees the silver grains of the film in focus in the magnified area, he knows the whole picture is critically sharp. This procedure enables even over-exposed negatives to be focused with precision.

Ernest Gardiner's own family coat of arms. He is seen below at work at his unusual hobby



Claws of eagles in heraldic designs are bits of thread glued in place and covered with varnish

Below is another of Gardiner's creations. Symbols are carved of wood and mounted on a pine base

Carved Coats of Arms

FORM PROFITABLE HOBBY

BETWEEN fire alarms, Ernest Gardiner, superintendent of the Baldwin, N.Y., fire headquarters, relaxes by carving out coats of arms, the hereditary ensigns of families descending from the Middle Ages. His hobby started four years ago when he saw a picture in a Sunday newspaper of the coat of arms of his own family. He carved out a reproduction in white pine and painted it realistically with oil paints. It turned out so well that he looked up the coats of arms of friends and relatives and made carvings of them, too. Soon orders began coming in and, during the past two years, he has sold sixteen.

To finish one of his carvings takes about thirty-five hours. The different heraldic symbols—the lions, fishes, birds, powderhorns, stars, gauntlets, ships, crescents, and other figures—are made separately and glued in place on a white-pine oval base. The lettering is made by beating fine copper wire flat and gluing it to the wood. After the correct colors have been applied with oil paints, the whole is given several coatings of transparent varnish.

Before he can begin work, Gardiner has to look up the exact form and coloring of the coat of arms of the family ordering the carving. Sometimes, he consults books in half a dozen libraries before he succeeds in finding what he wants.

Besides several penknives and half a dozen ordinary wood-cutting tools, he uses a small stylus to form the plastic scrolls, and two specially designed carving instruments. In addition to the wall carvings, Gardiner is now carving book ends decorated with coats of arms and heraldic devices.

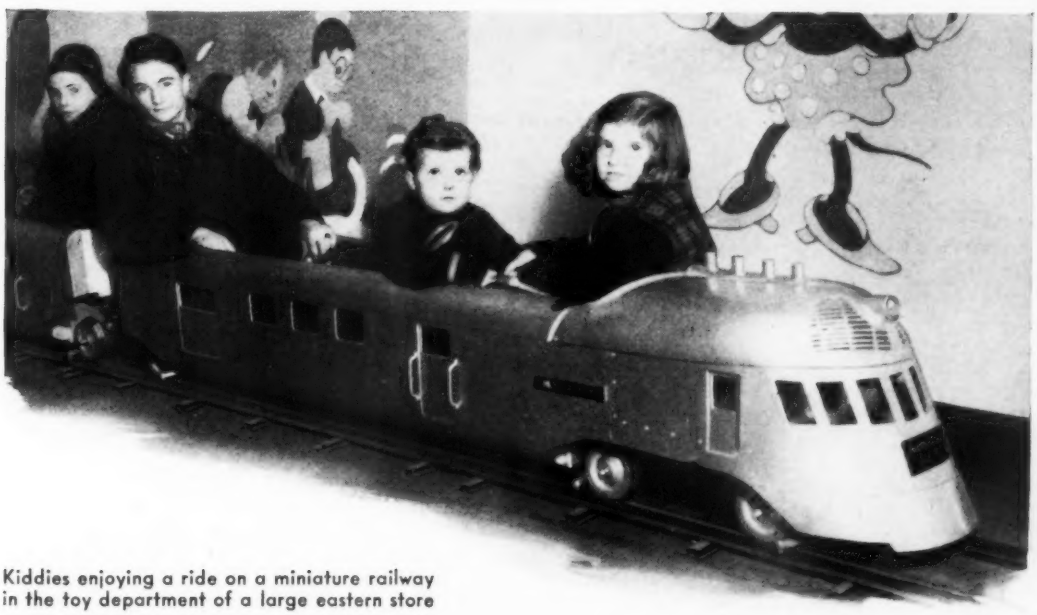
Curving around the back of the chair, this tray holds accessories

Curved Tray Aids Hairdressers

COSMETICS, hairpins, and other articles are kept in a convenient position by a new hairdressing tray designed for beauty-shop use. Adjustable for height on a metal supporting column, the semicircular tray is shaped to fit around the back of a customer's chair. The tray shelf has a high rim to prevent objects from sliding off, and compartments for pins, bottles, and other accessories.

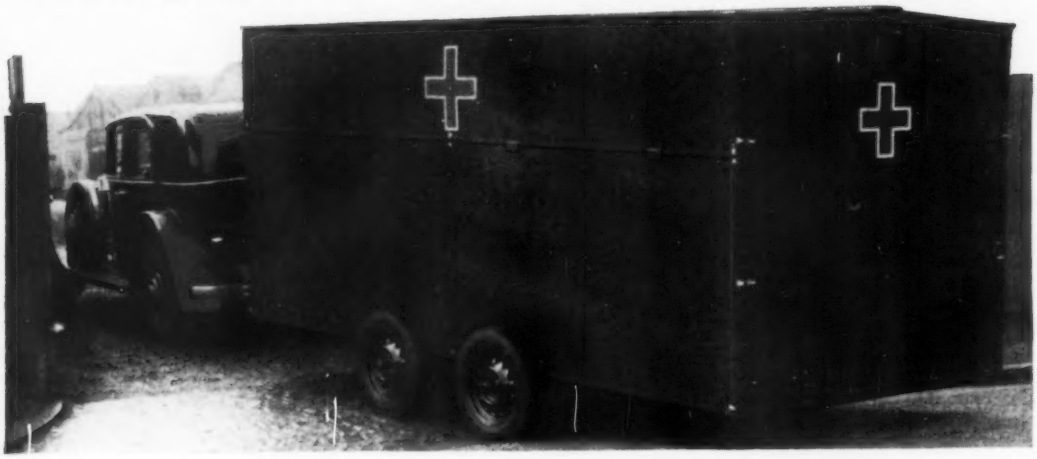
Midget Streamliner Tours Toyland

POWERED by electricity, the miniature streamline train pictured below runs in a 200-foot circle around the toy department of a large eastern store, carrying a load of fourteen children. Installed as a means of attracting young customers to the store's toy department, the Lilliputian streamliner is thirty-two feet long and runs on ten-inch-gauge track. A youngster seated at the rear of the head car operates the controls.

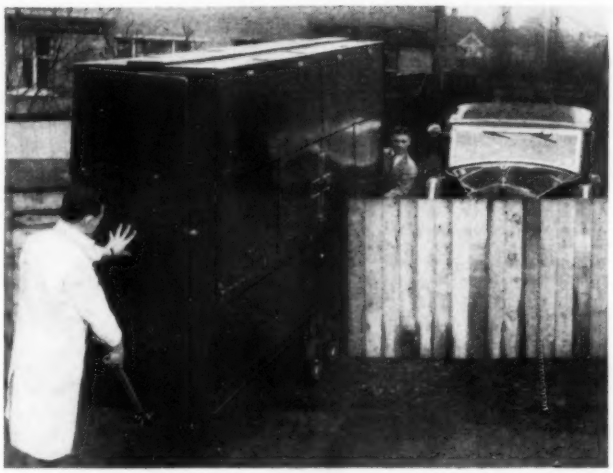


Kiddies enjoying a ride on a miniature railway in the toy department of a large eastern store

Collapsible Air-Raid Trailer Ambulance



TOWED behind an automobile or truck, a collapsible trailer ambulance invented recently in England is designed for emergency use in case of wartime air raids. When the folding ambulance is fully extended, it provides a central aisle for the use of a nurse or doctor in attending a total of twelve persons, placed six on each side, on stretchers arranged above one another like triple-deck bunks. So that it can be stored in a small space, and also maneuvered along sidewalks when roadways are blocked, or slid through restricted openings in barricades, the unit folds to a width of two feet, four inches. In collapsed form, it can be pushed along easily with hand trucks by two men, as pictured in the photograph at the right.



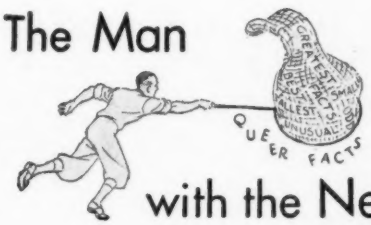
Folded twelve-bed ambulance being maneuvered through a narrow gate. In the upper photograph, the trailer is shown extended

Pumped full of air, the novel gloves seen above are said to reduce danger of injury

Pneumatic Boxing Glove Cushions Punches

RESILIENT, air-cushioned boxing gloves, designed to minimize injuries in sparring practice or during actual bouts, are the invention of Joseph Slizus and Milton Kairis, of Seattle, Wash. In uninflated form, the pneumatic glove lies flat, with a wrist band at one end and a grip at the other, as shown in the inset at the left. When the band is laced snugly about a boxer's wrist, and he clenches his fist around the grip, air is pumped in through a valve to balloon the fabric out into the shape of a lightweight regulation boxing glove of the conventional type.

The Man with the Net



SOUTHERN SIDES *of New York skyscrapers receive 350 percent more sunshine than northern sides.*

GASOLINE TANKS *on the new super-Clipper flying boats hold enough fuel to run an automobile more than twice around the world.*

GIRLS *have more toothaches than boys.*

VISIBLE *smoke from one cigarette weighs .0031 ounces.*

JASMINE *flower petals lose as much as a hundredth of their weight in a day through the evaporation of perfume oils.*

FOURTEEN HUNDRED *different shades of cosmetics are used by American women.*

WRENS *at Westfield, N. J., used 188 nails, seven pieces of bent wire, one screw, and one safety pin in building their nest. The material weighed three quarters of a pound.*

DAY *starts at East Cape, Siberia, the most easterly point on the International Date Line.*

TEN MILLION *Americans suffer from some form of allergy.*

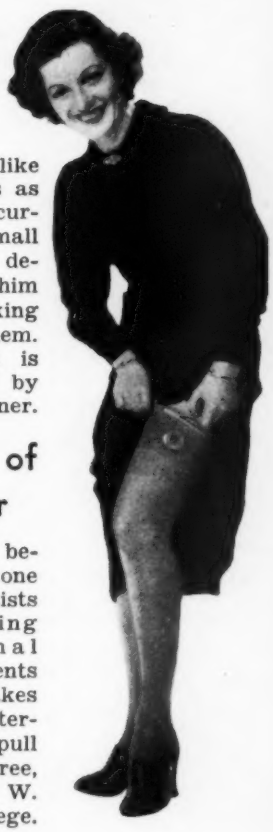
AUTOMOBILES *running on wood gas are being widely built in Russia.*

RATS *three feet long live in Dutch New Guinea.*

Electric Needle Roasts Weenies from the Inside

SPEARED on an electric needle and then incased in a metal cylinder, hot dogs are cooked from the inside out in an electric roaster invented by Abraham Shafer, of Philadelphia, Pa. The electric frankfurter fryer makes the dogs more digestible, the inventor claims.

Stocking Top Has Pocket for Compact



SINCE many women like to use their stockings as storage places for currency and other small items, one inventor decided to cater to this whim by designing a stocking with a pocket in the hem. The stocking pocket is opened and closed by means of a slide fastener.

Gravity Warns of Quake Danger

GRAVITY, hitherto believed constant at any one place, may give scientists warning of impending earthquakes. Normal earth-surface movements that precede earthquakes compress the soil, altering the gravitational pull to a measurable degree, according to Prof. G. W. Bain, of Amherst College.

POPULAR SCIENCE *Question Bee*

Test your knowledge of the language of science. Try to pick out the one correct statement in each of the numbered items below, and compare your results with the list on page 238

1 You can carry a heavy pole or log most easily by holding it near its *(a)* point of inflection *(b)* angle of incidence *(c)* center of gravity *(d)* line of least resistance.

2 What you eat goes down your *(a)* pelorus *(b)* esophagus *(c)* hiatus *(d)* meniscus.

3 The Heaviside layer *(a)* contains the earliest known fossils *(b)* reflects radio waves back to earth *(c)* surrounds the nucleus of an atom *(d)* lays welded railroad track.

4 To measure the humidity of the air, you would use *(a)* a hygrometer *(b)* a hydrometer *(c)* a humidor *(d)* an aquastat.

5 The path of a projectile's flight is called its *(a)* itinerary *(b)* trajectory *(c)* anticline *(d)* sine curve.

6 Electric current flows readily through *(a)* mica *(b)* porcelain *(c)* mercury *(d)* pure distilled water.

7 A fleet Asiatic leopardlike animal is known as the *(a)* howdah *(b)* rajah *(c)* hookah *(d)* cheetah.

8 To locate a star in the sky, you would need to know its right ascension and its *(a)* declination *(b)* parallax *(c)* albedo *(d)* metacentric height.

9 Things like chinaware and pottery are called *(a)* alembics *(b)* ceramics *(c)* quadratics *(d)* polemics.

10 What the ancient Greeks did with their triremes was to *(a)* eat them *(b)* row them *(c)* smoke them *(d)* play tunes on them.

11 The ore known as pitchblende yields *(a)* aluminum *(b)* mercury *(c)* iron *(d)* radium.

12 If you suffer from presbyopia, you need *(a)* more green vegetables *(b)* an artificial larynx *(c)* quinine *(d)* eyeglasses.

13 A group of closely related plant or animal species is called a *(a)* dynasty *(b)* tong *(c)* bloc *(d)* genus *(e)* cabal *(f)* caucus *(g)* cycle.

14 Halogens *(a)* give rise to antibodies when introduced in the human system *(b)* cause colored rings about the sun and moon *(c)* include chemical elements like chlorine and bromine.

15 The great pyramids of Egypt served as *(a)* lightning rods *(b)* markers for oases *(c)* royal tombs *(d)* fortresses.

16 Sailing a zigzag course against the wind is called *(a)* warping *(b)* tacking *(c)* boxing the compass *(d)* keelhauling *(e)* coming about *(f)* jibing.

17 You could generate electricity with *(a)* a galvanometer *(b)* a dynamometer *(c)* a magneto *(d)* an electrolier.

18 Gasoline has been made from coal by *(a)* oxidation *(b)* hydrogenation *(c)* regeneration *(d)* expropriation.

19 An enormous craterlike pit in northern Arizona is believed to have been created by *(a)* Inca miners digging for gold *(b)* the explosion of a huge natural deposit of fulminate of mercury *(c)* the treading of countless dinosaurs around a desert water hole *(d)* the impact of a giant meteor.

20 A person in charge of museum exhibits is called a *(a)* coroner *(b)* curator *(c)* collectivist *(d)* cassowary.

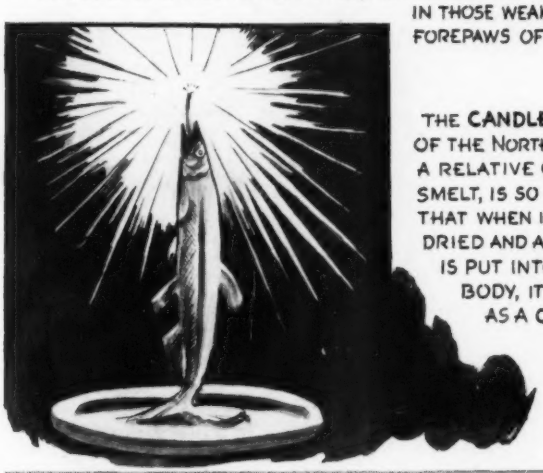
Now It's YOUR Turn—

WOULD you like to make money by submitting interesting, entertaining questions for this page? We will pay $1 for each one accepted for use. No entries will be returned. Address the Question Bee Editor, Popular Science Monthly, 353 Fourth Avenue, New York City.

Un-Natural History

By Gus Mager

JUST AS THE **SEAL** IS A BORN JUGGLER, SO THE **KANGAROO** IS A NATURAL BOXER! TRAINED TO BOX WITH HUMANS IN EXHIBITION MATCHES, HE PACKS A MIGHTY WALLOP IN THOSE WEAK-LOOKING FOREPAWS OF HIS!

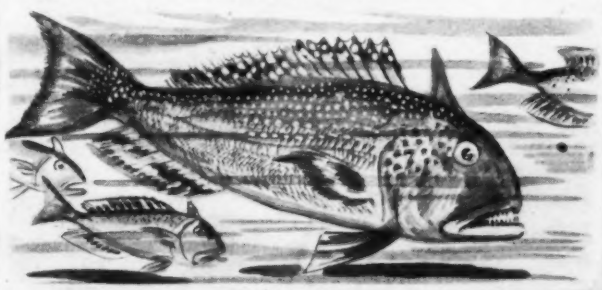


THE **CANDLEFISH** OF THE NORTH PACIFIC, A RELATIVE OF THE SMELT, IS SO OILY THAT WHEN IT IS DRIED AND A WICK IS PUT INTO ITS BODY, IT SERVES AS A CANDLE!

HERONS FLY WITH THEIR NECKS CURVED BACK AND THEIR HEADS BETWEEN THEIR SHOULDERS, **CRANES** WITH THEIR NECKS OUTSTRETCHED! YET BOTH FLY WITH TRAILING LEGS!

ANOTHER DIFFERENCE IS THAT **HERONS** BUILD BULKY NESTS OF STICKS IN TREES, WHILE **CRANES** BUILD WITH REEDS ON THE GROUND!

ONE OF NATURE'S MYSTERIES IS THE **TILEFISH**! IT FIRST APPEARED IN 1879, AND THREE YEARS LATER IT VANISHED, LEAVING MYRIADS DEAD IN THE SEA! REAPPEARING IN 1892, IT HAS STEADILY INCREASED IN NUMBERS!



SMALLEST WEB-FOOTED BIRD KNOWN IS THE **STORMY PETREL**, WHICH IS ONLY SEVEN TO SEVEN AND A HALF INCHES LONG. FLYING FAR FROM SHORE, IT CAN WALK ON THE OCEAN WITH ITS WEBBED FEET!

New Appliances

NOVEL COFFEE MAKER. Attached to the spout of a teakettle of the "whistling" type, the coffee-making device at the left consists of a curved metal pipe with a perforated coffee basket. Boiling water, forced up the pipe by steam pressure, runs into the basket. The coffee drips into a waiting pot

BATHROOM CONVENIENCES. Self-adjusting to fit any tub, the vanity tray below provides a mirror, a tray for cosmetics and accessories, and a removable grid that serves as a rest for the care of the feet

TWO-WAY TUB SEAT

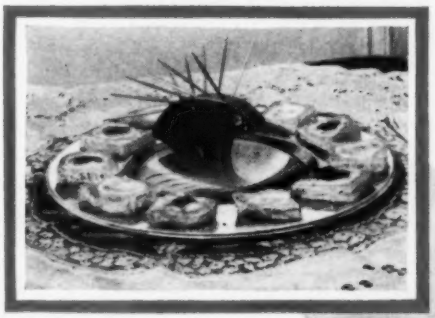
In one position, the handy bathroom fixture seen below serves as a conventional bath seat. When the seat is raised to the tub edge as shown, it is used as a stool

SAFETY GRIP. Bathtub falls, a frequent cause of injury, are less likely if you use this clamp-on safety grip. A pivoted bar holds towels handy, just in case you get the soap in your eyes

for the Household

DOUBLE SCRAPER

The dish scraper below has two blades, a rubber one for soft foods and a metal one for hard or dry foods. They are changed by pushing a thumb lever



VERSATILE TRAY

Interchangeable center units for this serving tray include a casserole, cheese board, fruit or salad dish, and "porcupine" holder for tidbits on sticks. The latter is seen in use above. The tray alone can be used as a sandwich server

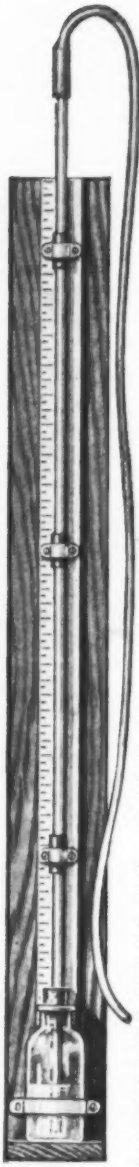
DOUBLE-DUTY IRON

Its reversible handle allows this electric iron to be set up on its stand for steaming, as below, or inserted in sleeves for pressing from the inside

TAPERING TEAKETTLE

Greatly increased heating efficiency is claimed for a novel teakettle which resembles an inverted funnel. In the picture below, the two-quart kettle is seen in use

Gus Builds a Motor Tester



"IT'S a grand day, isn't it, Gus?" breezed Dr. Marvin, as he pulled up at the shop door of the Model Garage one morning. "But," he added ruefully, "I'd enjoy it a lot more if my car was running better."

"What's the trouble?" Gus Wilson asked, stepping out into the sunlight.

"That's just what I don't know," the doctor told him. She just doesn't run quite right, that's all. Bucks when I'm running slow in high gear, for one thing."

"What sort of a doctor are you?" Gus demanded.

"Huh? Oh, I see. Why, I'm a pediatrician—a kid's doctor, in plain English."

"Well, Doc," Gus said, "when you're called in to attend some youngster you don't know, and you're not certain just what's the matter with him, what's the first thing you do?"

"Nine times out of ten," Dr. Marvin said, "I put my stethoscope on him, and see how he's ticking inside."

Gus grinned. "Well," he said, "I'm a sort of gas-engine doctor. I'm going to put a stethoscope on your engine, and see how it's ticking inside. Only I call my stethoscope a vacuum tester—or a trouble shooter. Drive her in, will you, Doc?"

From a cabinet Gus took a dial-faced instrument to which was attached a length of rubber tubing. After connecting the free end of the tube to the car's intake manifold, he hung the instrument on a handy nail and adjusted the car's throttle so that the engine would run a trifle faster than idling speed. Then he and Dr. Marvin watched the black hand on the dial. It moved steadily up the scale to 20, stayed there for a moment, dropped back to 15, climbed to 20 again, dropped back to 15, climbed again.

"Sticky valve," Gus said. "That's a lot easier than the old way of pulling an engine half apart to see what's wrong with it, isn't it? If you know how to use one of these vacuum testers, it'll show up almost anything that can go wrong in an automobile engine." He disconnected the tube. "Phone sometime when you're not going to need the car for a couple of hours," he suggested. "I'll send Harry over for it, and we'll check these valves."

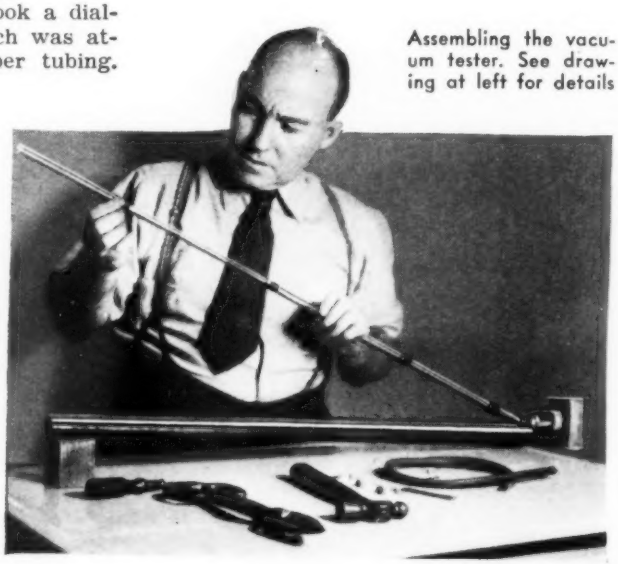
"All right, I will," Dr. Marvin said, absent-mindedly. He picked up the vacuum tester and examined it interestedly. "Quite a gadget," he remarked. "Darned if I wouldn't like to have one, only I suppose it would be a waste of money for me, with only one car and mighty little time to work on it."

"Maybe so—maybe not," Gus said. "I can show you how to make a vacuum tester that'll do the work pretty nearly as well as this one, and that will set you back less than a dollar. Doing anything this evening?"

"Nothing special," Dr. Marvin told him. "There's one case I might get a hurry call on, but—"

"Tell them to switch your hurry call over here," Gus said. "You come over about eight, and we'll go to it—won't take us over an hour or so. Oh, by the way, Doc—bring along a small bottle, will you? Two-ounce size."

After the customer had driven off, Joe



Assembling the vacuum tester. See drawing at left for details

Gus connected the rubber tube to the intake manifold. "Watch the mercury column," he said

Clark came out of his little office, shaking his head accusingly at his partner.

"Yeah, I heard you," he said. "You'll never be a business man, Gus. Now, when my missus calls Doc Marvin over to look at one of the kids, do you think he tells her how to find out what's wrong with the youngster, and what to do about it? No siree! He does the job himself, and puts the five bucks in his pocket. How can we make money if you tell our customers how to do their own trouble-shooting?"

"You're right, Joe," Gus grinned. "I'm no business man, but I know that there's such a thing as good will. If a man likes to tinker with his car, and I tell him how to do a fifty-cent job for himself, it's a pretty sure thing that when he has a fifty-dollar job, he'll bring it to us."

When Dr. Marvin got around to the Model Garage that evening, he found Gus at his workbench planing off a piece of three-quarter-inch board thirty-two inches long and four inches wide. "Thought I'd better get started on the carpenter work," Gus remarked. He screwed a four-inch-square piece of half-inch stuff to the longer board, so as to form a shelf at its bottom. "There—that's the backboard of our trouble shooter," he said. "Bring that little bottle, Doc?"

Dr. Marvin produced a two-ounce bottle. "Right!" Gus said. He motioned toward a pair of metal shears and a piece of sheet tin lying on the workbench. "While I sandpaper this backboard," he directed, "you cut off a half-inch strip of tin maybe a foot long—we'll need it to make straps. Now let's have that bottle."

He measured it with his eye, snipped off a piece of tin long enough to make a strap from the half-inch-wide strip that the doctor had cut, placed the bottle carefully on the center of the shelf at the bottom of the backboard, and screwed on the tin strap so that it held the bottle securely in place.

"Now for our scale," he said. "I had a nice, clean yardstick somewhere around here—yes, here it is. It has an ad for Henry Miller's

By
MARTIN BUNN

hardware store on it, but it will serve the same purpose as the scale on the dial of that tester we were using on your car this morning."

He cut the yardstick off at its thirty-two-inch mark and nailed it to the center of the backboard so that its lower end was even with the top of the bottle. Then he poured quicksilver into the bottle until it was about half full, and produced a rubber stopper from one of his pockets.

"Notice this stopper, Doc, in case you ever want to make another of these gadgets," he said. "You'll see that I've drilled a hole in it big enough to push a quarter-inch-diameter glass tube through—with a tight fit—and that I've also cut a little triangular air notch in one side of it."

FROM the shelf over the workbench he took a thirty-six-inch length of glass tubing and a five-foot length of quarter-inch rubber tubing. From the rubber tubing he cut three half-inch pieces which he worked over the glass tube so that the lower piece was about twelve inches from the tube's lower end, the middle one about twenty-two inches, and the upper one about twenty-nine inches. "They're to keep the tube from breaking when I strap it onto the scale," he explained. Then he inserted the glass tube in the rubber bottle stopper and pushed it through carefully until its end reached the bottom of the bottle. "That's important, Doc," he cautioned. "You've got to get the end of the tube just as far down in the bottle as you can without actually touching the bottom."

Fastening strips of tin over the half-inch pieces of rubber tubing with thin screws extending through the yardstick scale into the backboard, he strapped the glass tube firmly to the scale. Then he worked an end of the length of rubber tubing over the upper end of the glass tube, and surveyed the job with satisfaction.

"There she is, Doc," he said. "Didn't take over an hour to build, either. Maybe she's not quite as shiny and impressive-looking as a bought vacuum tester, but she'll do a good job of trouble-shooting for you.

"Now I'll show you how she works," Gus went on. "Let's try her out on my car."

He got into his ancient but perfectly kept coupe, started its engine, and let it run until it was thoroughly warmed up. Then, leaving the engine running, he got out, raised the hood, disconnected the windshield-wiper hose from the intake manifold, and connected the free end of the trouble-shooter tubing in its place. "Watch the mercury column in the glass tube, Doc," he said. "It will go up to about the twenty-inch mark, and stay there. How about it?"

"Right!" Dr. Marvin said, his eyes on the quicksilver. "It's at twenty inches, and it's steady there."

"Now," Gus said, "I'm going to retard the spark. The mercury will drop to about sixteen inches."

"Right!" Dr. Marvin said again. "It's down to sixteen inches."

"Any engine that is functioning properly," Gus explained, "will pull the mercury column of this trouble shooter up to about twenty inches on the yardstick scale. If you hook it onto an engine, and the quicksilver goes up to only sixteen inches, there's a chance that the trouble is a retarded spark. So, before you go any farther, check over the ignition system to make certain that plugs, breaker points, and spark advance are set according to the factory specifications. After you have done that, hook on the tester again. If the mercury still refuses to climb, you'll have to do some more trouble-hunting.

"Perhaps the difficulty is that the carburetor isn't adjusted correctly. Make your mixture leaner and richer, and note at which point you get the highest reading on the scale. That's the point at which your carburetor should be adjusted. Now, Doc, you bring your car in, and we'll find that sticky valve."

Dr. Marvin drove his car into the shop. Gus attached the tester tube to its intake manifold. "Just let the engine idle," he said. "Now watch the mercury column. See how it drops periodically, and then climbs again? That's a sure indication of a sticky valve. Now we'll find out which valve is sticking." He removed the valve cover plate. "Watch the valves open and close, and at the same time keep an eye on the mercury column," he said. "It will drop when the sticky valve opens. There she is—No. 3 cylinder.

"YOU can use your trouble shooter to adjust valve tappets, too," he went on as he straightened up. "Get your engine real hot, and then close the tappet clearance of each valve—one at a time, of course—until the mercury column begins to drop. Turn the tappet adjusting screw to clear the valve, and stop just as soon as the mercury column stops its sudden drop. That's a good way to cure a noisy tappet—and still be certain that there is enough clearance to keep the valve from holding open or burning.

"This homemade trouble shooter will tell you a lot of other things about an automobile engine. If the mercury column keeps oscillating pretty rapidly between fourteen and twenty inches, it shows that the valve guides are worn, and should be replaced. If the engine, while idling, won't pull the mercury column above six or seven inches, look for a blown gasket in the intake manifold, between the carbu- *(Continued on page 240)*

THE HOME WORKSHOP

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Easter-Egg Novelties

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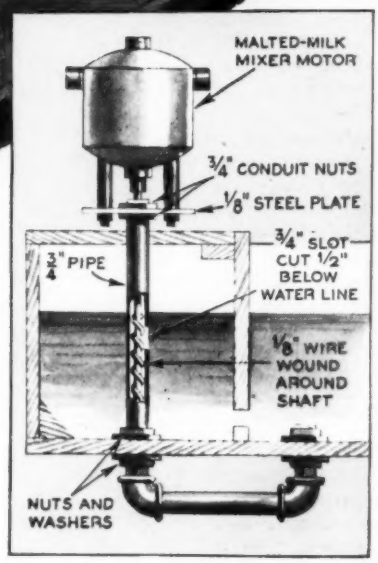
Winners of Goofy-Bird Contest

SECRETS OF SUCCESSFUL Tank Farming



At one end of the wooden tank is a sump with the circulator (an old malted-milk mixer), float valve, immersion heater, and thermostat

MUCH has been told of the marvelous results obtained by tank farming, but little about exactly how it is done. This article is intended to remove the mystery and show amateur gardeners the latest methods used in this new science of plant culture, often known as soilless farming, hydroponics, or water culture.

Groups are springing up everywhere in California to try their luck at this fascinating type of gardening. This interest is largely due to the efforts of Prof. William F. Gericke of the University of California.

In tank farming the solution is held in a tank, and the vegetable or flower plants are grown in trays resting on top. Elements required by the plants are added to the wa-

By
EDWIN G. GETTINS
Technical Director, California Tank Farm Study Group

Amazing growth of tomatoes, potatoes, onions, flowers, and other plants is obtained by water culture. In a small way experiments may be made in pans as shown above, but a tank is better

ter in the form of soluble salts.

For best growth, the solution must be kept at a uniform temperature and also circulated, unless some method of air blowing is devised for aëration. The tank illustrated has provision for both heating and circulating the solution automatically.

Fasten the sides, ends, bottom, and three bottom ties with screws in preference to nails. See list of materials for sizes. Use casein glue on all the joints. Put in the center baffle, but notch out a piece 1½″ by 6″ on the bottom at the sump end. Add the sump wall pieces, corner pieces, center braces, and sump filler pieces. Drill 1″ holes for the ¾″ pipes and the return hole to the sump, and a 1⅝″ hole for the sink drain.

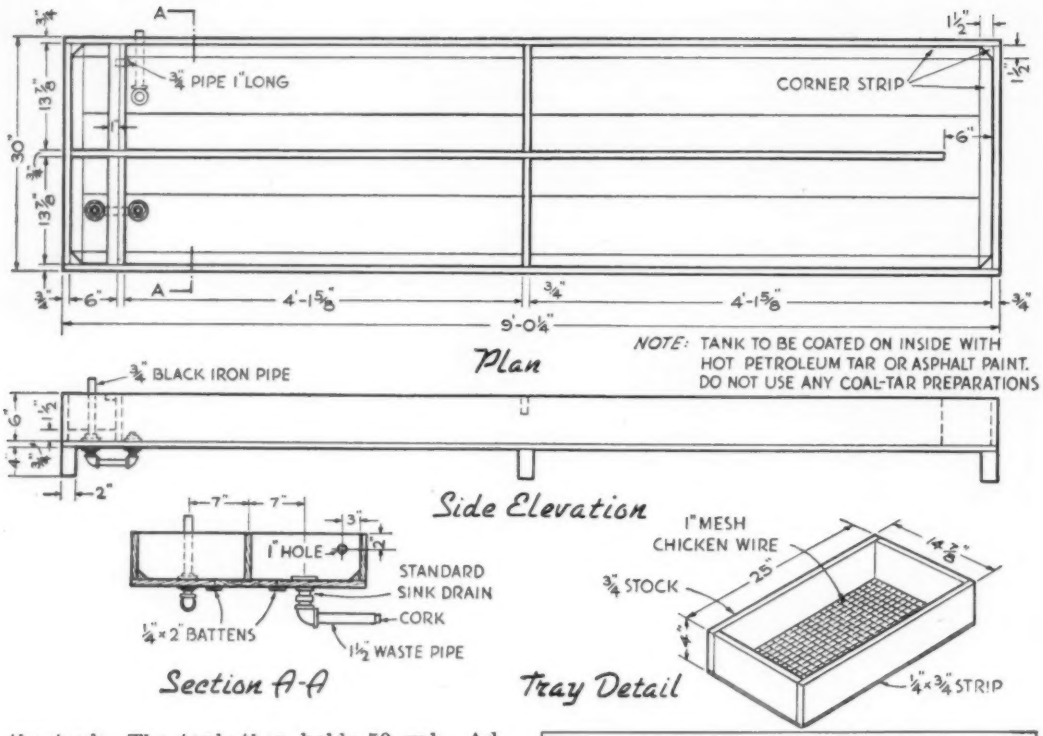
Install all pipes and fittings. Take care that the ¾″ by 11″ nipple is mounted so that the ¾″ slot, which should be cut in it as shown, is ½″ below the water line. The water line is 2″ below the top of the tank and runs through the middle of the return hole. Add the bottom battens and apply the waterproofing.

A wire helix is fastened to the long motor-driven mixing rod as shown (the regular mixing disk being discarded) and the motor itself mounted by the method indicated. Note that the helix must be wound in a direction opposite to the rotation of the motor. The mixing rod should extend as far down into the pipe as possible. Pour water into the tank to inspect for leaks and test the circulator.

Assemble the eight wooden plant trays with corrugated fasteners. Fasten chicken wire to the bottom of each tray with holding strips and flathead nails.

Now place the tank in its permanent location and level by filling with water to the top and driving wedges under the 2 by 4's. If it is possible to install the tank in a greenhouse, there will be considerable saving in the current required to heat the water, but the tank method is well suited to outdoor use. In fact, the experiments may be carried out successfully in warm weather without using a heating element.

Next, the float valve is connected and water is allowed to run out of the drain until it has reached the level line 2″ below the top of



the tank. The tank then holds 50 gal. Adjust the float to cut off the water at this point. A galvanized cover can be made for the float section, and wooden covers ¾" thick to accommodate the thermostat on one side and the ¾" pipe and heater on the other side. The heater should be mounted as close to the ¾" pipe as possible.

Fill the tank with water again to within ¼" of the top and connect up the electrical apparatus. One side of the line goes directly to the motor and heater, and the other passes through the thermostat before it reaches the other two.

The trays may now be set on the tank and pieces of galvanized iron screwed in place to prevent them from slipping. Excelsior is placed on the wire tray bottoms, and a number of wicks are formed by poking bunches of excelsior about 3" down into the water. Put in about 2½" of excelsior and fill to the top of the trays with rice hulls, chaff, or pine or oak shavings (avoid redwood shavings).

If enough excelsior wicks have been made, the tank will be ready for planting in an hour. Wash all dirt from the roots of the plantlets and set them in holes made in the moist top filler and excelsior right down to the wire. Plants can be very close together. Seeds may also be started directly in the trays, but the average experimenter doesn't want to wait that long for results.

The current is now turned on. It will take about six hours to raise the temperature of

LIST OF MATERIALS

No. Pc.	Description	T.	W.	L.
3	Bottom	¾"	10"	9'-0¼"
2	Sides	¾"	6"	9'-0¼"
1	Center baffle	¾"	6"	8'-4¾"
2	Ends	¾"	6"	2'-6"
2	Sump walls	¾"	6"	1'-1⅞"
3	Bottom ties	2"	4"	2'-6"
2	Sump filler pieces	¾"	1"	1'-1⅞"
16	Tray sides	¾"	4"	2'-1"
16	" "	¾"	4"	1'-1⅞"
	Triangular corner strips	1½"	1½"	25'
	Battens	¼"	2"	18'
	Hold-down strips	¼"	¾"	50'

NOTE: All sizes are net except the 2 by 4's. Use spruce, pine, fir, or white cedar. Avoid redwood.

MISCELLANEOUS

10' chicken wire, 1" mesh, 24" wide.
1 black pipe nipple ¾" by 11", threaded 3½" on one end, standard thread on other.
1 close black pipe nipple ¾" by 3".
1 black pipe nipple ¾" by 6", standard.
4 black iron ¾" pipe nuts and 4 washers.
1 standard 1½" sink drain with compression fitting for 1½" nipple.
1 close black pipe nipple, 1½".
1 black ell, 1½", and 2 ells, ¾".
1 gal. asphaltic paint, or 10 lb. petroleum tar. (Avoid coal-tar preparations.)
1 aquarium thermostat, 500 watt, and a 500-watt aquarium heater or immersion heater.
1 chicken-yard float valve, ½".
1 malted-milk mixer motor or equivalent.
1 pc. mild steel plate 3" by 3" by ⅛".
16' single wire, rubber-covered drop cord and 1 plug.
½ lb. casein glue.

the water from 60 to 85 deg. F. Keep an accurate thermometer in the water until this temperature has been reached; then turn the adjusting knob on the thermostat to cut off the current.

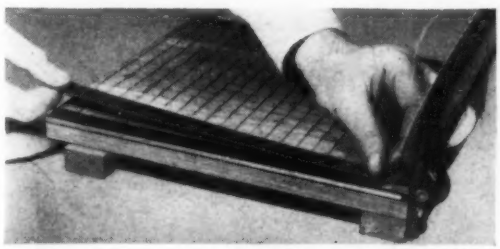
Chemicals do not need to be added for a few days after transplanting, or until the roots begin to grow into the water. I suggest tomatoes for the first experiments. The following solution, from the Ohio Experimental Station, is especially recommended for tomatoes: Potassium nitrate, 3 oz.; calcium nitrate, 3 oz.; magnesium sulphate, 1¼ oz.; mono calcium phosphate, ⅜ oz.; ammonium sulphate, 3½ oz. Dissolve each in about ½ gal. of water separately and pour them into the tank in the order given.

In addition, 2½ oz. boric acid must be dissolved in ½ gal. of water, and 1 fluid oz. placed in the tank once each week. Also dissolve 8¾ oz. ferrous sulphate in 1 gal. of water and add to it ½ fluid oz. of sulphuric acid solution (1 oz. concentrated acid in 31½ oz. water). Put 1 fluid oz. of the iron solution into the tank once a day.

The degree of acidity or alkalinity (the pH) is most important. For tomatoes pH 5.5. has been found satisfactory. A test set can be obtained that consists of papers impregnated with a dye and an accompanying color chart, each color bearing a pH number ranging from pH 4 to pH 10. One of the strips is dipped into the tank and the resulting color reaction compared with the chart. As the solutions tend to become alkaline, it is necessary occasionally to add a small amount of the dilute sulphuric acid. If the solution should go over too far on the acid side, use a small amount of potassium or sodium hydroxide solution (a pellet dissolved in a quart of water). When one becomes familiar with the routine, the correct pH is easily maintained.

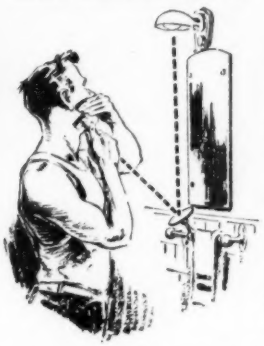
This solution, although recommended for tomatoes, will also work satisfactory with cucumbers, squash, and most flowers.

The circulator, when operating, forces the solution down the ¾" pipe from the sump up into the bottom of the tank, where it moves gradually around the center baffle and returns through the hole in the sump. There it picks up additional heat before going through the same cycle again. When the temperature of the water reaches the established high point, the thermostat cuts off both the circulator and the heater.



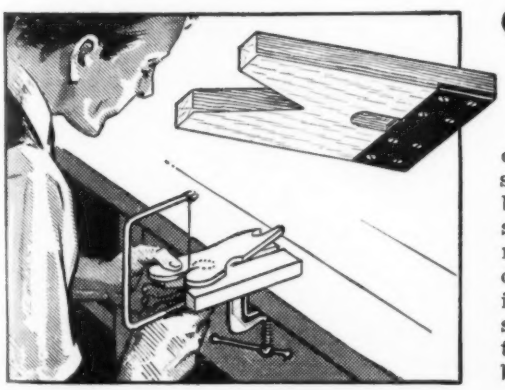
Tape Improves Print Trimmer

LARGE photographic prints are sometimes ruined because they slip on the trimming board while being squared up. I overcame this by putting photographic masking tape along the edge.—WILLIAM SWALLOW.



Mirror Reflects Shaving Light Upward on Face

IN THE average bathroom there is usually a single light over the mirror, but it is somewhat unsatisfactory for shaving because it throws a shadow under the chin. This difficulty may be overcome by attaching a rear-view mirror to the towel rack or to any available projection as illustrated. Light can then be reflected upwards.—H.S.

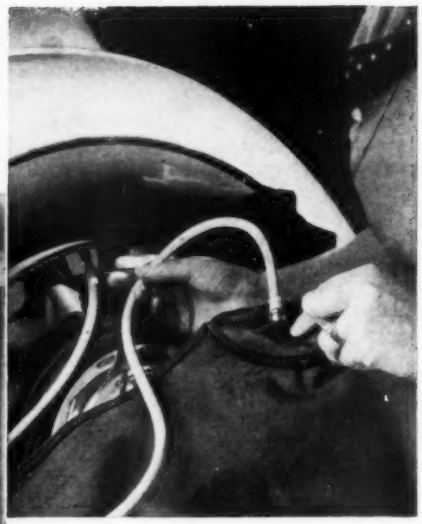


Clamping a Wooden V-Block to Workbench or Table

A WOODEN block with a V-cut in the end is frequently required for supporting thin metal or wood while cutting it with a jeweler's saw or scroll saw. A convenient way to clamp such a block on a bench or worktable is shown. A ½" slot is cut into the center of the block from the rear, and a heavy metal strip is set into the underside, running across the slot. The C-clamp is applied in such a way as to hold the metal strip against the top of the bench. The clamp then does not project, and the surface of the block is left clear.—R.W.

Air Mattress Inflated from Spare Tire

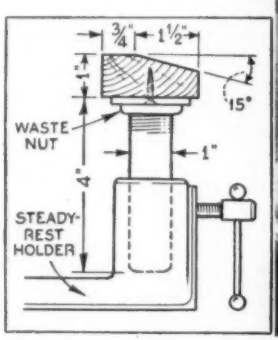
The tire will fill at least two mattresses. Note how a nail is used to manipulate the valve



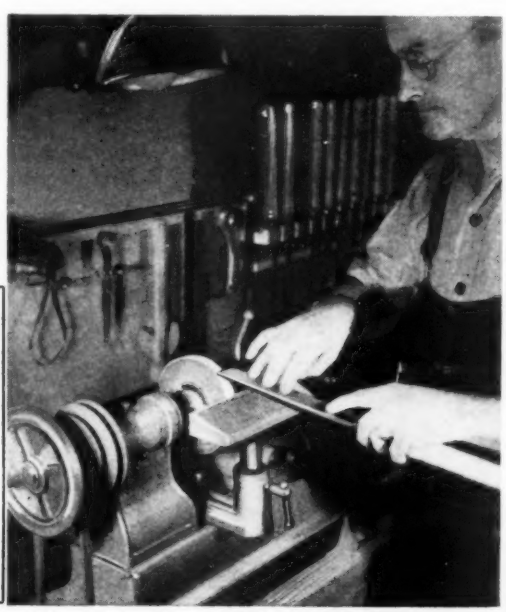
TO INFLATE an air mattress without effort, obtain a short piece of rubber tubing small enough to slip snugly over the valve of the air mattress and the valve of your spare tire. A nail is then pierced through the side wall of the rubber tubing near one end so it can be manipulated to press against the tire valve to allow the air to flow into the mattress. The nail will seal itself in the side wall of the tube, thus preventing leakage. Add a few pounds of air in the spare when starting on a trip.—WALTER F. DEBOLD.

Adjustable Grinding Rest for Sharpening Chisels

TRUE bevels on wood-turning and other chisels may be obtained by using this homemade rest. The top is maple or other hardwood 6" long. It is fastened with ¾" No. 6 flathead wood screws to a 4" length of pipe on which a waste nut has been tightly screwed with a pipe wrench. If the steady-rest holder has a 1" hole —a common size— obtain ¾" size pipe and a ¾" waste nut. Adjust the rest up or down as required.



The homemade grinding rest and, at right, how it is used. The pressure should be on the beveled part of the rest

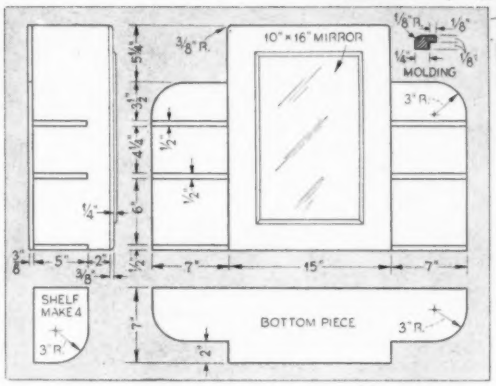


Modern Bathroom Cabinet

FILLS NEEDS OF LARGE HOUSEHOLD

EVERY home needs a capacious bathroom cabinet. The one shown is easily made, convenient to use, and much larger than usual.

Two shelves are put inside the cabinet proper, spaced 5″ and 10½″ respectively from the bottom. This brings them between the outside shelves so that all the shelves can be attached without difficulty. In assembling, attach the four boards forming the cabinet to the back; then add the outside shelves, and finally the inside shelves, using 1″ flathead wood screws. Hang the door with 1″ brass butt hinges. The mirror, 10″ by 16″, is held with a simple molding.

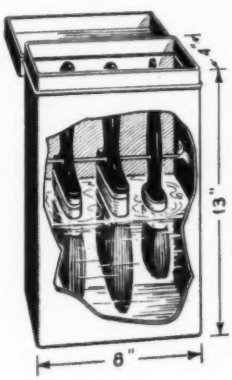


The door is ⅜″ plywood 15″ by 20½″; the back is cut from same material 20½″ by 29″. Remainder of stock is ½″ white pine. Use 1″ screws in assembling

One coat of flat white paint and two coats of white enamel are applied, and a glass knob and spring-type door catch added. The cabinet is mounted with two ¼″ by 2½″ lag screws set into expansion shields so that the comparatively heavy weight will be solidly supported.—CHARLES BATTY.

BRUSH KEEPERS

[PAINTING]



Paint and varnish brushes are best preserved by hanging them in a can containing a suitable liquid. The bristles should clear the bottom of the can by 1″. An excellent type of keeper, which has a cover to exclude dust, is illustrated. Note that the wire passes through holes in the handles of the brushes, and the ends of the wire are supported in stirrups soldered inside the can. For varnish brushes, use a mixture of half varnish and half turpentine. For paintbrushes, use half linseed oil and half turps. Fill the can until the liquid reaches halfway up the tin ferrules. A different method, however, is required for shellac or lacquer brushes. These should be washed clean in the proper solvent and stored dry.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Cutting out the lid. If a band saw is used, as in this instance, the entering cut is filled afterwards

OVAL-SHAPED

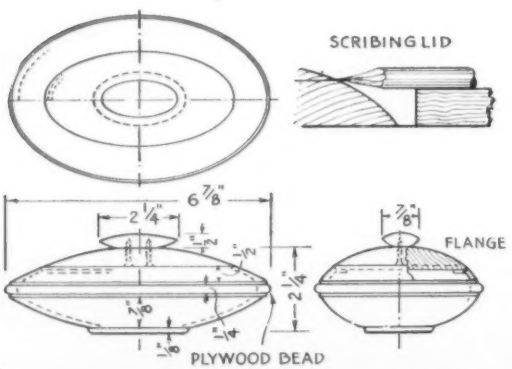
Novelty Box

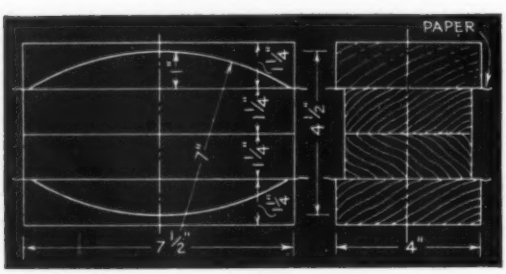
TURNED ON THE LATHE

ALTHOUGH turned on the lathe, this unusual box is oval in shape. It can be made in many sizes and proportions, as the dimensions are merely a suggestion. The oval plan is obtained by the use of an old turning trick. Merely glue two pieces of wood to a center core, with a sheet of paper in each joint, and turn at medium speed. A cardboard template will help make the lengthwise arc accurate. After turning, split the pieces off with a chisel and hollow the lower section. Scribe the other section for the lid and saw the lid on an angle, about perpendicular to the surface. The rim is hollowed by sawing nearly parallel to the surface.

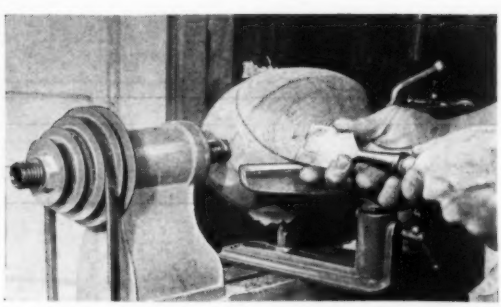
Sand the sharp outer edges to show a narrow flat band, and glue together with a plywood bead inserted between. To hold the lid in place, glue a flange of plywood to the underside of the lid. It is sanded to thickness when dry. Smooth the edges of the lid with plastic composition wood, fitting them loose enough to allow for the paint. The handle is a solid block carved and attached with screws, while the base is a plywood ellipse sawed out at an angle to fit the box.

Other designs for novelty boxes appear on pages 160 and 184.



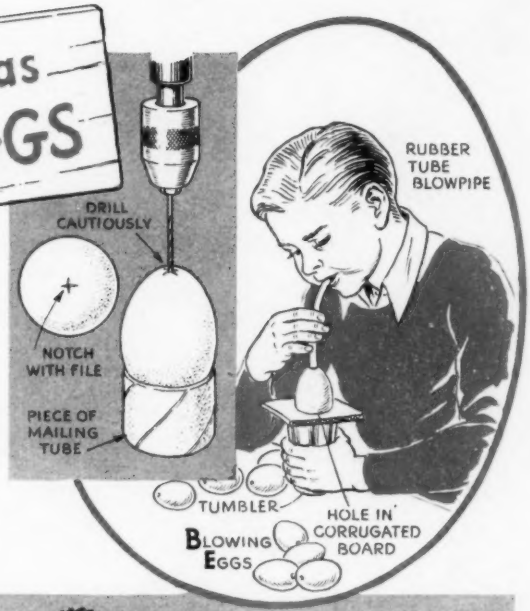


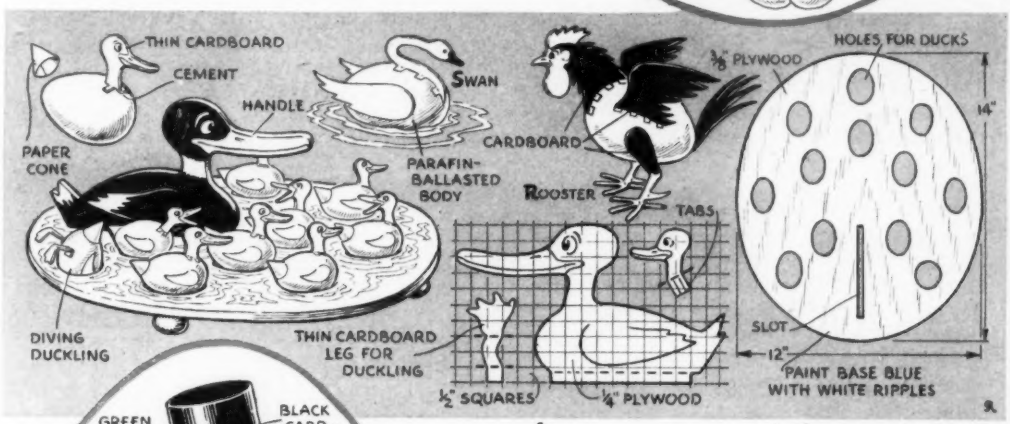
The stock for the box is glued to a core with paper between, for ease in splitting the parts off after they have been turned. When the block has been turned to shape, scrape the wood with a chisel held obliquely as at right

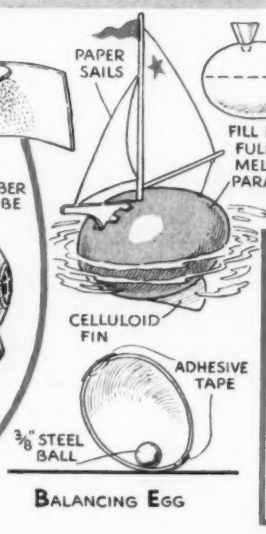


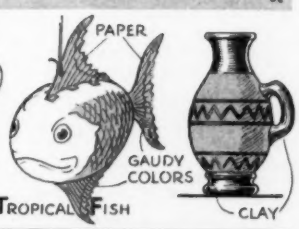
Strictly Fresh Ideas for EASTER EGGS

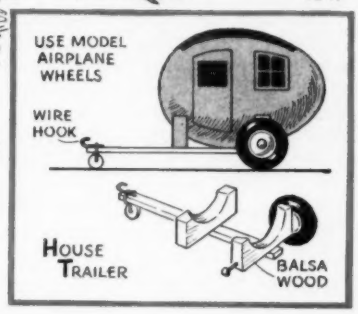
IF THE eggs used in making these novelties are blown by the method illustrated, the contents may be used for the table in the form of an omelet or scrambled. Clean the shell with soap and warm water, especially if water colors are used in decorating. Sails, wings, legs, and other parts may be fastened on with model-airplane cement. Features are modeled in artist's clay of the self-hardening type.—HI SIBLEY.



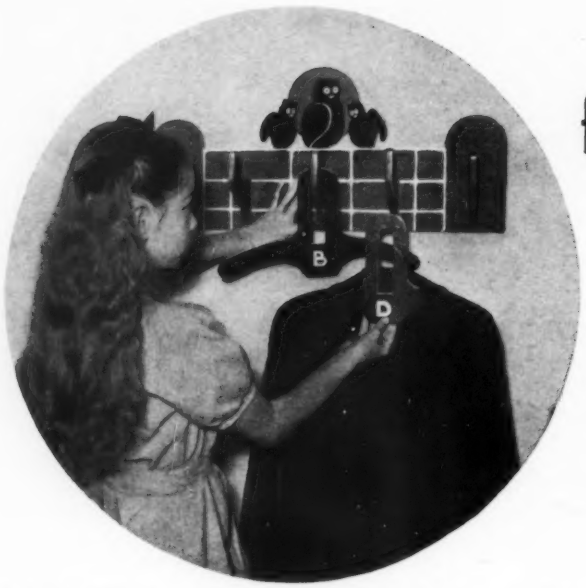






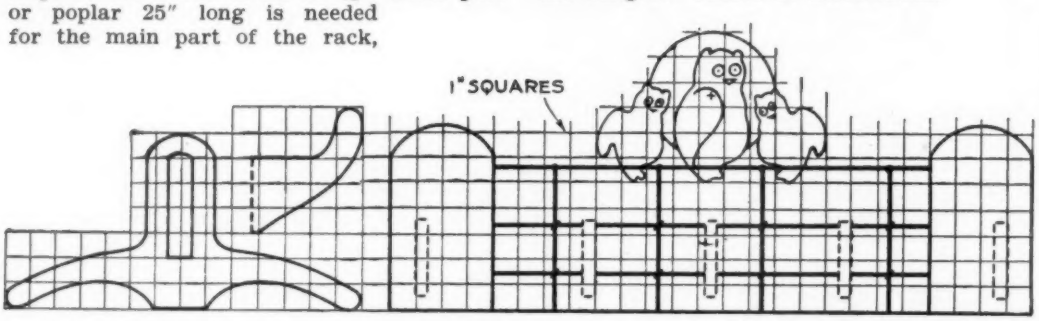


A Rack for Children's Wraps



WHEN placed low on the wall of a hall closet, this rack gives children a place where they can hang their wraps without help. A 12″ wide board of ½″ white pine or poplar 25″ long is needed for the main part of the rack, scraps of material of the same thickness but preferably hardwood for the five hooks, and ¼″ plywood for as many coat hangers as desired. Cut out the two small spaces under the moon and between the owls, and mortise the five hooks securely in their places.

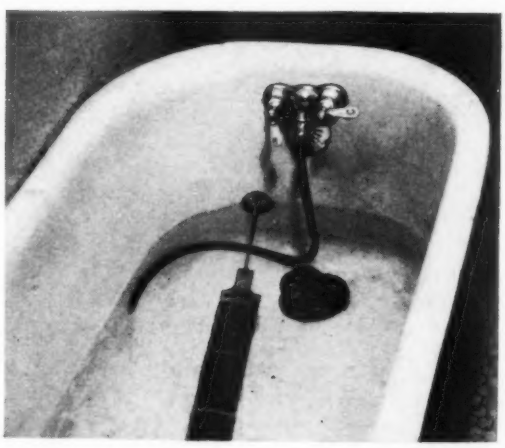
Enamel the rack light brown, the owls and the coat hangers very dark brown, and the moon and the features of the owls bright yellow. Use aluminum paint for the wire fence (on which the owls are sitting), edges of rack and coat hangers, and first-name initials on the hangers—HAZEL F. SHOWALTER.



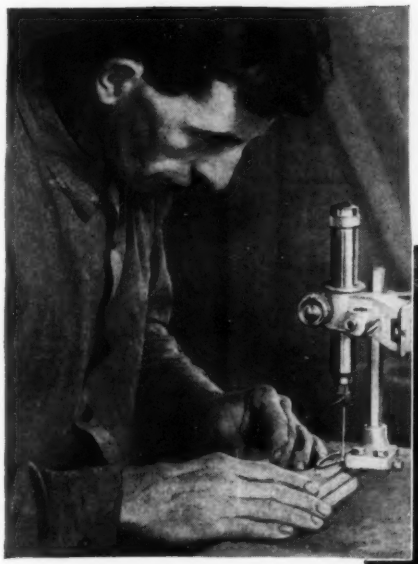
Patterns for the backboard or main part of the rack and for the hooks and hangers. These may be enlarged to full size by means of the squares. The five hooks are mortised securely into the backboard

Suction Cups Hold Film While Being Washed

ROLL film may be washed in less than the usual time and without the slightest danger of scratching the surface by holding it taut in the bath tub through the use of two coat hooks with suction cups attached, which may be bought for a dime or less. Rubber bands connect the hooks with the clips on the ends of the film. By arranging a rubber hose as shown and adjusting the stopper so that the water will maintain a constant level, great efficiency in washing is obtained. A number of rolls may be suspended similarly and washed at the same time.—K. M. S.

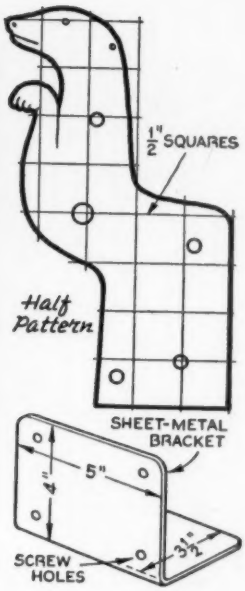


Unique Book Ends
COPIED FROM
ESKIMO SPEAR RESTS



The two book ends are bradded together through the waste wood and then shaped with a jig saw

Completed book end. At the right is the metal bracket and pattern for the bears



ESKIMO skill in ornamenting useful objects with animal forms is illustrated in these book ends. They were copied from ivory spear rests carved to represent polar bears. Made as paired halves lashed together with sinew, the spear rests were originally bound to a kayak near bow and stern.

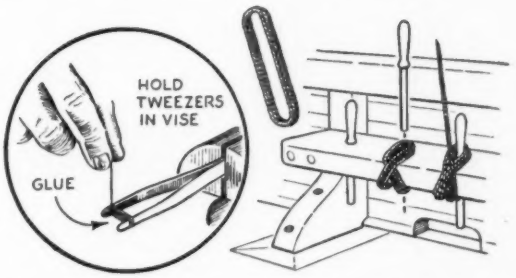
Cut the two book ends at once from pieces of wood ⅜" or ½" by 5" by 4½" after bradding them together through the waste wood. Of course, if larger book ends are desired, the dimensions may be increased. Slit the mouths, toes, and center divisions with a knife, drill the holes, and round off the outer corners. Ivory enamel, rubbed to a silky finish, presents an excellent appearance.

After painting them, thread pieces of leather shoe lace through the center holes, cutting the ends off flush inside. Screw on sheet-metal brackets bent as shown. Cover the bottoms and inner surfaces of these brackets with thin felt to prevent scratches from the metal.

Instructions for making a trinket box, also of Eskimo design, were given in a previous issue (see P.S.M., Mar. '39, p. 163).—E. M. LOVE.

Rope Coils for Ship Models Wound on Tweezers

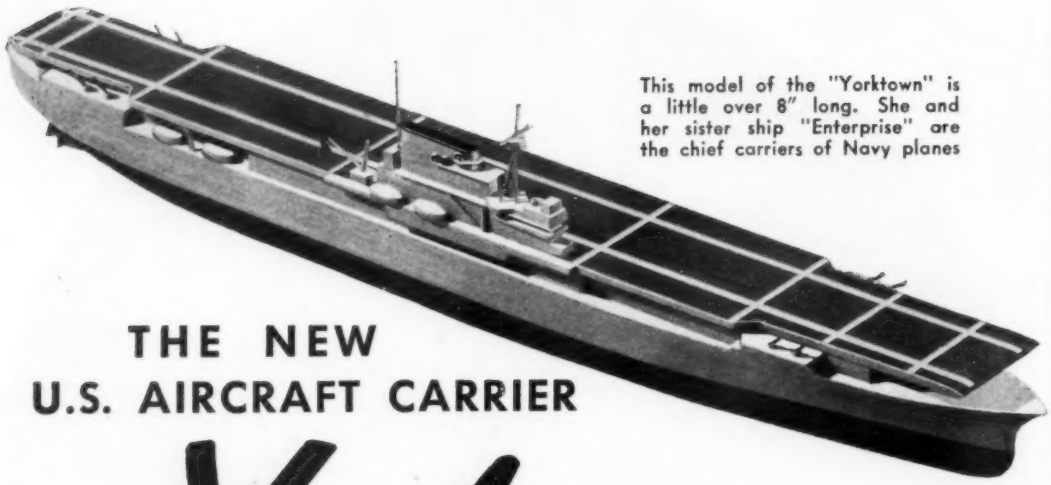
MINIATURE coils of rope to put on the belaying pins of a ship model may be wound separately on tweezers, as shown. The turns are fastened with a touch of glue or shellac and removed by compressing the tweezers.—S. P. ROBBINS.



After winding the coils, place glue on the threads; then remove the strands by compressing the tweezers

Cleaning Lead Screw of Lathe

A GOOD way to clean the lead screw on a lathe is to run the machine at high speed with the lead screw engaged. Dip an old toothbrush in oil and hold it against the screw, letting it follow the thread.—R. R. P.



This model of the "Yorktown" is a little over 8" long. She and her sister ship "Enterprise" are the chief carriers of Navy planes

THE NEW U.S. AIRCRAFT CARRIER

Yorktown

A Miniature Model Designed Especially for the POPULAR SCIENCE MODEL-of-the-MONTH CLUB

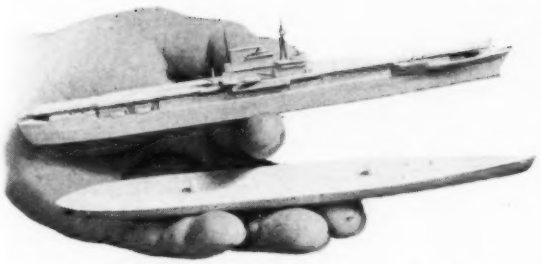
By THEODORE GOMMI

The hull is made in two parts, divided along the water line. This simplifies painting the underwater part black and the remainder gray

FOR the third model in our series of new American warships, we have chosen the aircraft carrier *Yorktown*, which, together with her sister ship *Enterprise*, are the most important units of the Navy's aircraft force. Because they were designed especially for the purpose, these two ships carry 142 planes each, almost twice as many as the larger converted battle cruisers of the *Saratoga* class.

To conform to the previous ships of this series, the model is built to the scale of 1" equals 100'. The drawings are, however, quite complete so that anyone who desires a larger model can enlarge the dimensions. The plans on the next page are half size.

The flat decks of the prototype lend themselves well to the layer method of construction. Simply by cutting the strips of wood specified in the list of materials to the shapes



The two parts of the model before being painted. Note how pegs are used to hold them together temporarily

LIST OF MATERIALS

WHITE PINE, BASSWOOD, OR BALSA

No. Pc.	T.	W.	L.	For
1	¼	1	9	A
1	3/16	1	9	B
1	⅛	1	9	C
1	⅛	3/16	1⅜	J
4	1/16	1	9	D, E, F, and G
1	1/16	1	9	H, I, K, Q, R, W, and boats
1	1/32	3/16	2	L, N, O, and P

MISCELLANEOUS

1 piece of cardboard about 1" by 6" for M, S, T, U, and rudder.

4 round wooden toothpicks (use points only) for V.

14 small beads for gun bases and searchlights.

24" thin, stiff wire for masts, guns, cranes, etc.

4 pins about 1½" long for screws (propellers).

Black, gray, maroon, and yellow paint. (Or cover deck with maroon-colored paper and use yellow crayon for the stripes.)

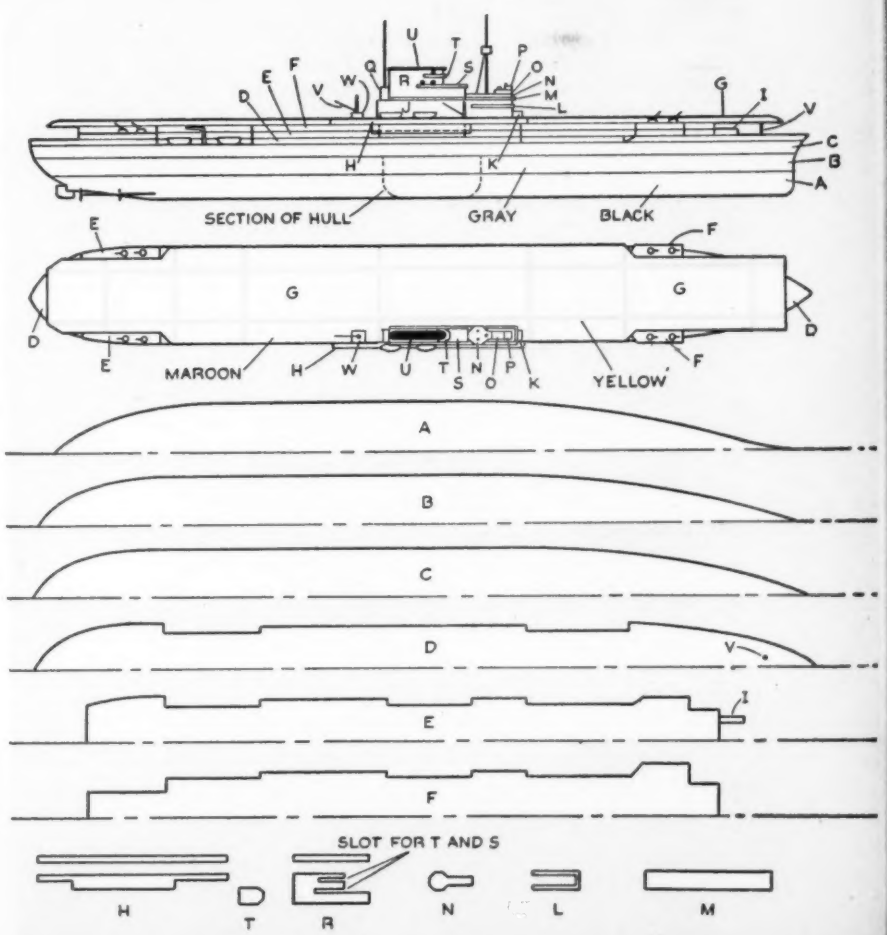
NOTE: Dimensions are given in inches.

shown in the drawing, the entire hull may be correctly built up. (To save space, only the port side contours are shown, but these are exactly the same on the starboard side.) With sandpaper, the "corners" can be removed from the layers, and the hull will quickly take shape.

The stern is similar in shape to that of our *North Carolina* model, and the rudder and screws are similarly attached.

The "island" superstructure contains the only small details of the model. The plan views of the principal parts of this superstructure are given in separate drawings. Small beads are used for the searchlights and thin wire for the masts. The deck cranes are made of toothpick points *(V)* with wire arms. The cranes in the hull recesses, however, are made entirely of thin wire, bent to shape. The guns are short wires inserted into the hull through beads.

The underwater portion of the hull *(A)* is black, the remainder of the model gray, except the flight deck, which is deep maroon with yellow stripes. Keep *A* attached to *B* by wooden pegs during the construction so that *A* can be painted separately before the assembly.



Plans of the "Yorktown" drawn exactly half size. Consult the list of materials for thicknesses of the principal parts. The flight deck is maroon color with yellow stripes

Miniature Track Scales

WEIGH MODEL RAILWAY CARS

TRACK scales are very important in industrial railroading, yet few model railroad layouts incorporate any sort of device for weighing car-loadings.

The base of these scales is made of wood of slightly greater thickness than the height of a track tie. The bumper may also be made of wood, but it should be quite rigid. The removable scale house may be made of tin, wood, cardboard, or other material.

One end of a section of track is hinged to the base as shown. A tie and a small section of another piece of track are screwed to the base to provide a means for coupling to other sections. A stiff T-shaped piece of metal is bolted to the opposite end of the hinged section at the tie and fastened to the coil spring under the bumper. If it is planned to carry current in the third rail for any reason, a little thin paper insulation should be inserted under the tongue of the T-piece.

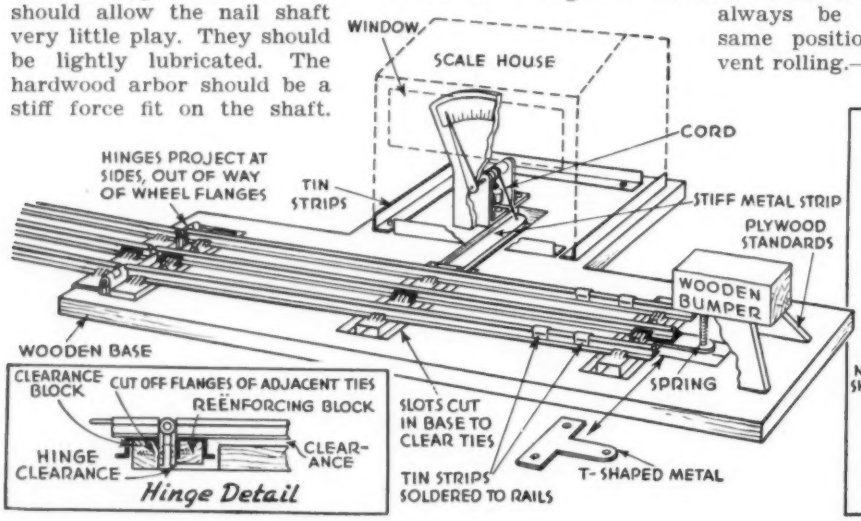
As it is the tension of the spring under the bumper that regulates the weighing, it may be necessary to experiment a little.

A stiff strip of metal is bolted to the center tie (or the one nearest the bumper). The strip extends inside the scale house, and to this end is fastened a piece of stout, stiff cord. The bearing holes in the brass brackets should allow the nail shaft very little play. They should be lightly lubricated. The hardwood arbor should be a stiff force fit on the shaft.

A shallow grove is cut in the arbor, and the free end of the cord from the track arm is fastened to this. A turn or two is taken around the groove, and an end left to fasten the return weight. Wrap a piece of wire around the shaft and use it for a temporary pointer to determine the size of the dial and the angular position on the shaft at which the pointer should be soldered.

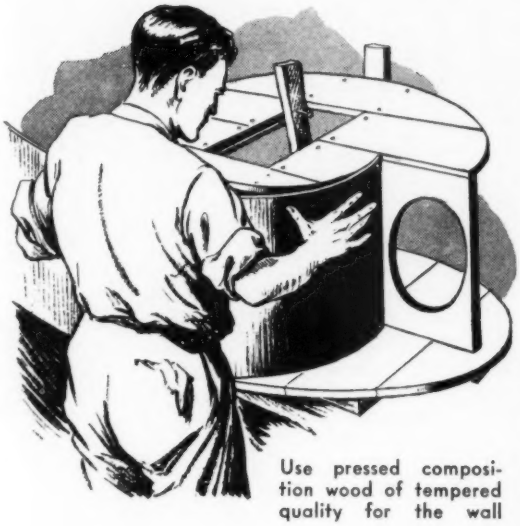
The dial may be made to read from the back or front of the scale house. Best appearance may be obtained by housing the entire inside mechanism in a tin case, using a second dial support for the back of the case. In calibrating, remember that weights of scale models vary in proportion to the cube of whatever linear reduction factor you may have been using.

The tin strips soldered to the rails near the bumper, as shown below, provide a slight obstruction to insure that cars will always be placed in the same position and to prevent rolling.—JOHN L. STORY.



SNAIL-SHELL DOG HOUSE

The unusual spiral design gives good ventilation without drafts



Use pressed composition wood of tempered quality for the wall

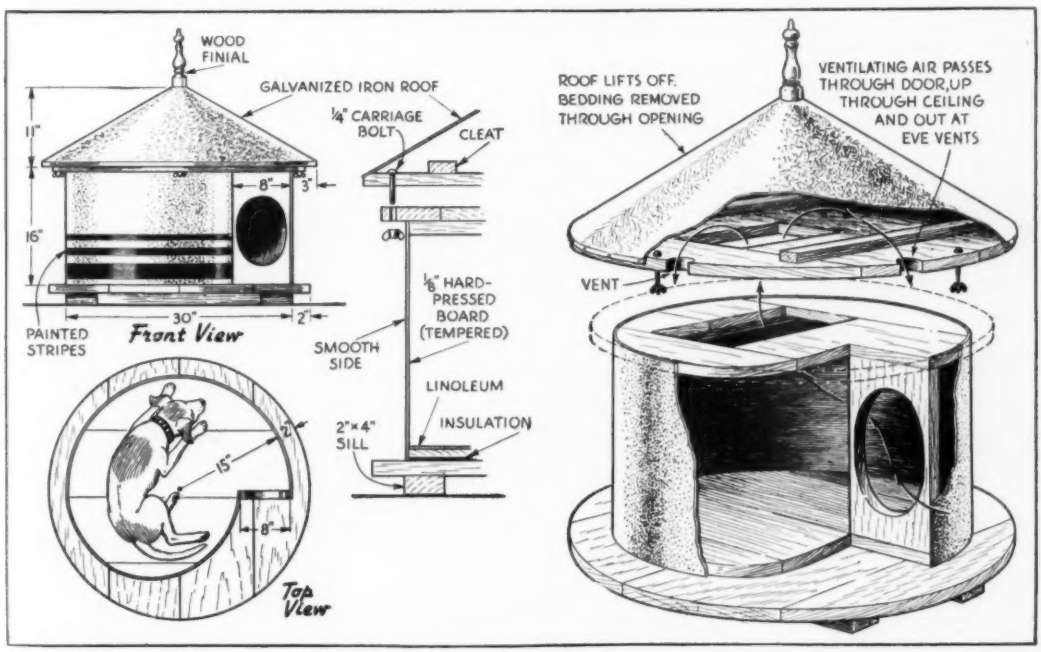
AMPLE ventilation may be provided in a dog house without the danger of drafts by building it so that the floor plan resembles to some extent the spiral of a snail shell. Another advantage of this design is that the roof may be removed by unscrewing four thumb nuts, giving access to the interior for cleaning.

First a circular base is made with three sills beneath. On this is nailed the spiral form to which the wall is secured. The ceiling is of the same shape.

The curved wall is of hard-pressed board of tempered quality. Use ⅛" thickness and install it smooth side out. There is a trick to bending it. First cut the panel 15" wide and 8' long, and drill for ⅞" No. 6 oval-head wood screws. These are to be used with washers and set about 3" apart. First fasten the end to the top and bottom units, beginning at the inner end of the spiral. Next bend very, very gradually around the curved members, having an assistant screw down the edges as you proceed. Do not relax the board once you have started to bend it. Trying to bend the board quickly will break it.

The roof is built up as a separate unit. It has notches around the eaves for the escape of foul air. Galvanized sheet in the form of a flat cone serves as roofing.

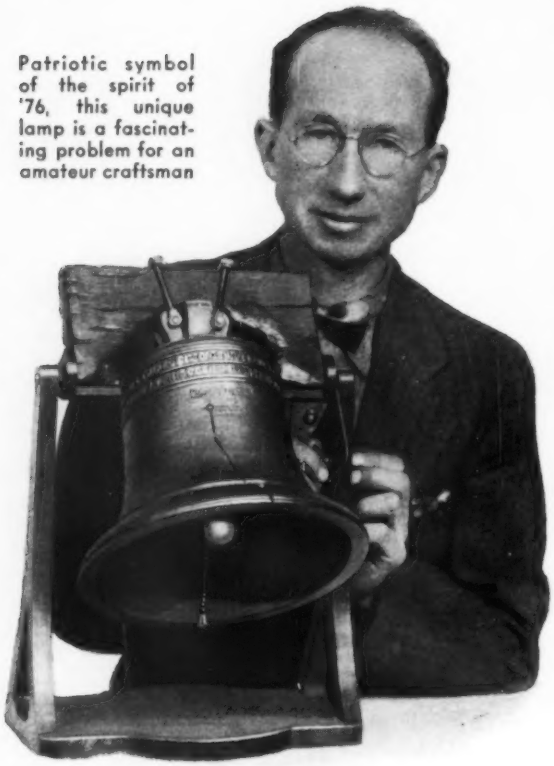
Lay linoleum on the floor and clean excelsior over that. The excelsior should be removed periodically and replaced with fresh. Paint as desired.—DICK HIXON.



Front and plan views, a sectional drawing, and a cut-away perspective sketch to make the construction clear

LIBERTY

TURNED AND



Patriotic symbol of the spirit of '76, this unique lamp is a fascinating problem for an amateur craftsman

By CARL G. ERICH

CRAFTSMEN who are looking for an original project will find a challenge to their skill in this Liberty Bell table lamp. Made almost entirely of wood, it involves an unusual problem in turning and carving.

Bell. Cut seven disks of 1⅛" white pine so they may be glued up to form the rough block. Cut the centers from all but the two top disks and the bottom one. Glue together with the grain crossing, and keep them as well centered as possible. Dry between two or three stout clamps for twenty-four hours or longer. Now center the lathe faceplate on the top (where there are two solid disks), place the whole in the lathe, and push the tailstock into place. Make a template as a guide in following the contour. Have your turning tools very sharp. Note that a recess about 1/16" wide and deep is turned above and below where the lines of lettering are to be carved later.

After turning and sanding the outside, start at the tailstock and begin turning the inside. Once you have gone through the solid disk of wood at this end, remove the tailstock. Place one end of a 4" tool rest inside the bell and turn the wall down to not less than ½". Sand the inside also.

Cut the crack on the side with a sharp pocketknife—⅛" deep, 1/16" wide. Measure around the bell where the lettering goes with a tape measure, lay out the length and width on a piece of paper, and draw the lettering to suit. Transfer the lettering to the bell with carbon paper, and be careful to place it in the right relation to the crack. Cut the letters with pocketknife and small chisels. All this carving is done while the bell is still in the lathe.

Top member. This is made as at *A* from a block 2½" square, and it is 2⅝" long, including the 1" dowels used to fasten it to the bell top. Drill four holes in the top of the bell to receive the dowels.

Beam. Use white pine 1⅛" thick. Burn and scrape the piece as shown at *C*, then brush with a fine wire brush to give the effect of rotted wood. Stain this a dark oak color. Cut two small disks as at *D*, also two small square strips as at *E*. Fasten *C* to *A* with four 2¾" by ¼" bolts. To do this flatten the heads and drill them for 3/16" rods, which go through member *A*. Also cut and throw away the heads of four ¼" bolts, insert the threaded ends in holes spaced as shown in the top of *C*, and add the nuts. These are merely for effect. Bore a hole through *C* and *A* to receive a pipe to which the light socket is later screwed.

Base and uprights. Cut these parts from ⅝" walnut.

Adjusting bracket. This is made from thin, stiff black sheet iron as at *B*. It may be cut on the jig saw or chiseled to shape. Fasten it to one end of *C* with two small screws. Place a 1¼" by 3/16" stove bolt on one upright for the adjusting plate to work on, and use a small

PROCLAIM LIBERTY THROUGHOUT THE LAND UNTO ALL THE INHABITANTS THEREOF LEV-XXV-X
BY ORDER OF THE ASSEMBLY OF THE PROVINCE OF PENNSYLVANIA FOR THE HOUSE IN PHILAD.
PASS & STOW PHILAD. MDCCLII

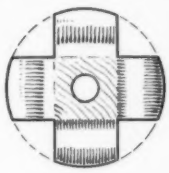
The lettering as it appears on the original Liberty Bell. Measure around the model with a tapeline and then draw the lettering to suit. The lines are placed as indicated in the drawing on facing page

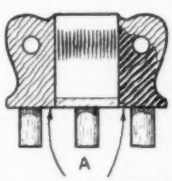
BELL LAMP

CARVED FROM WOOD

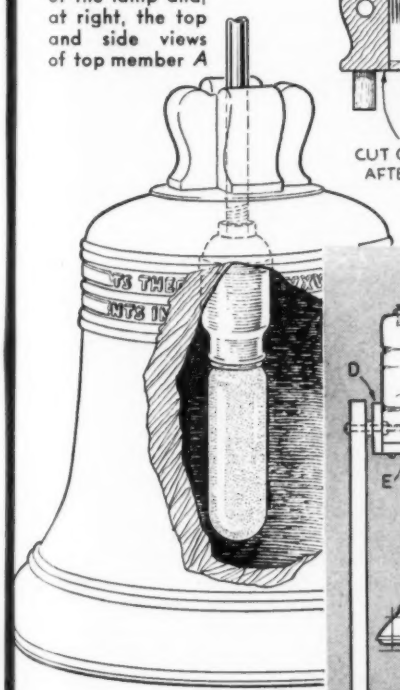
wing nut or some type of ornamental nut to hold the plate in any position desired.

Finishing. Assemble the parts as shown after boring four ¼" holes in the top of the bell for vents to allow the heat from the bulb to escape. Apply walnut stain to base and uprights. Give these and member *C* two coats of thin white shellac and rub lightly with very fine steel wool. Bronze the bell and part *A* with the darkest bronze you can get (such as the shade commonly called vernis Martin bronze). Wire lamp with an intermediate pull-chain socket and a metal reflector. A wooden knob resembling a clapper may be added at the end of the chain.

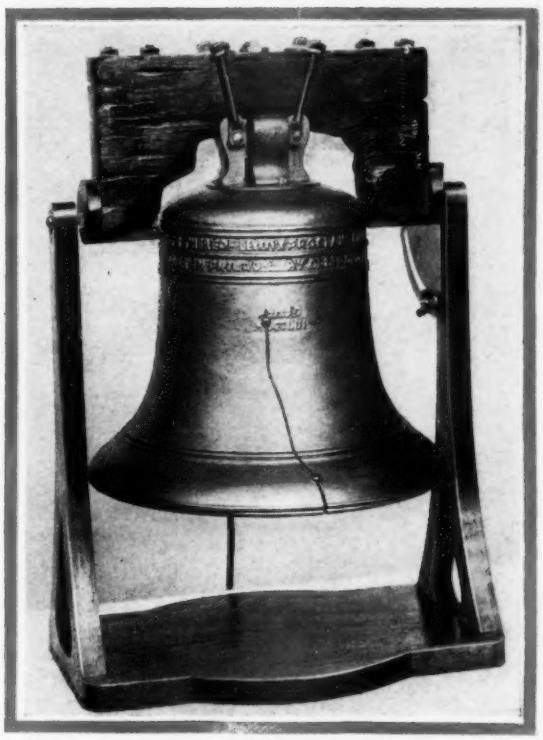




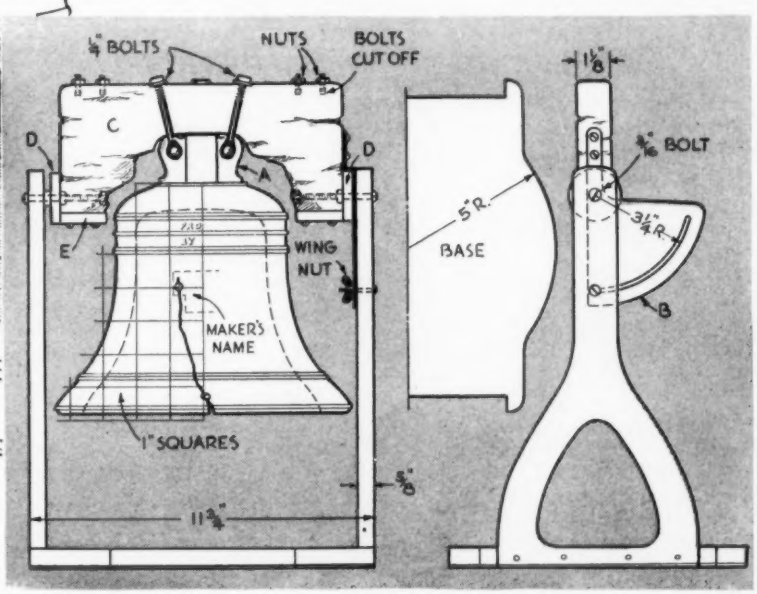
A cut-away view of the lamp and, at right, the top and side views of top member *A*



Use a tubular bulb for lamp. Note at right exactly where lettering is placed on bell



The finished lamp in its normal position. It may be tilted as desired by means of the adjusting quadrant



Amusing Jig-Sawed Figure Supports Trinket Box

After a full-size pattern has been drawn, the figure is cut from 1" wood. The base may be made any shape to harmonize with the box

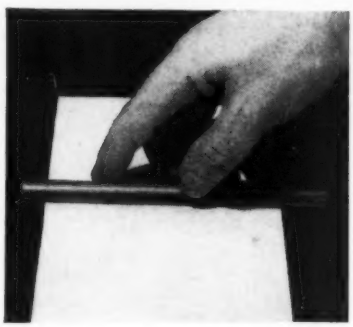
THIS little holder for a man's jewelry, collar buttons, cuff links, or nicknacks is in the form of a cheerful laborer lifting an apparently heavy box. Enameled in black, silver, and cream, it has a very modern air.

After enlarging the pattern on 1" squares, cut the figure from 1" thick wood. Obtain or make a suitable box or tray and fasten it with screws to the arm. Cut a 1" thick base, round, square, or oblong to repeat the shape of the box, and mortise the feet of the laborer to it. Instead of being a jewelry box, the design may be changed to an ash tray or a holder for cigarettes—according to the container fastened to it.—H.F.S.

Inexpensive Ferrotype Squeegee Made from Rubber Tubing

FOR removing excess water from the backs of prints when placing them in contact with ferrotype plates, a serviceable squeegee may be made from ⅜" or ½" rubber tubing of the required length. It should be reënforced with a snug-fitting wooden dowel of the same length.

Before applying the print to the squeegee plate, be sure to wash the polished surface with cold water. Enameled type plates require to be waxed occasionally, but chromium-plated squeegee plates need no lubrication.—E. B.

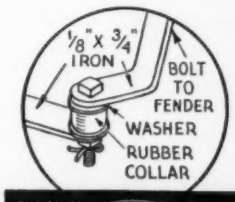


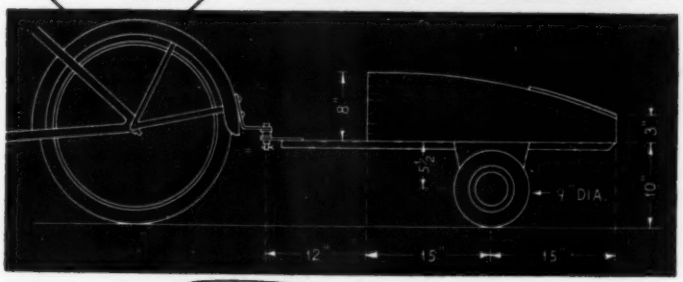
DIMENSIONS OF TYPICAL FURNITURE [FURNITURE]

Type	Description	Width	Depth or Length	Height
Bed, four-poster	Rails above floor 14" to 28"	60"	82"	84"
Clock, grandfather's		17¼"	9"	87"
Chest		20"	45"	19"
Chest of drawers	With four drawers	40"	20"	37"
Chair, dining	Front of seat 17½" wide, back 14½", height of back 34½"	—	16½"	18"
Chair, Am. Empire	Front of seat 19" wide, back 16", height of back 34½"	—	17"	17"
Corner cupboard	Colonial	33"	—	72"
Desk, knee-hole	Leg space 20" wide, 24" high	24"	44"	29"
Fire screen	Turned column, 3 legs	15"	18"	46"
Floor lamp	Turned column, 3 legs, round table	18"	18"	50"
Lowboy	William and Mary or Queen Anne	35"	20"	30"
Magazine basket	Modern	12"	18"	18½"
Revolving book rack	Round or octagonal, turned column	18"	18"	25"
Sideboard	Hepplewhite or Sheraton	72"	22"	38"
Stool	Cabriole or turned legs, upholstered	14"	20"	15"

POPULAR SCIENCE MONTHLY SHOP DATA FILE

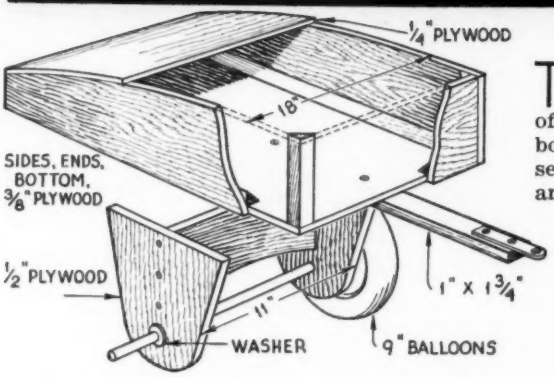
A rubber collar between the tongue of the trailer and the bicycle bracket, as shown below, makes a silent hitch. Right, the completed trailer





Bicycle Trailer

BUILT OF PLYWOOD



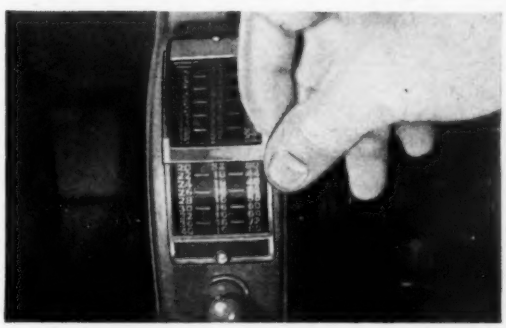
Plywood is used for the body, axle supports, and cross member. The wheels are of a commercial balloon type

THIS trim bicycle trailer combines lightness with strength, and a large number of packages may be carried within it. The body is constructed mainly of plywood, assembled with three-cornered cleats, screws, and glue. (Cleats of this type also make it easy to clean accumulated litter out of the corners.) Axle supports are braced with a cross member, and standard balloon wheels are used on the original model. The rubber collar inserted in the hitch makes for quiet running. Waterproof plywood is the best to use, but in any case give the wood two or three coats of shellac or paint it as desired.

Lathe Change-Gear Marker Slides on Index Plate

MADE from a small scrap of sheet brass, this little marker for the change-gear plate of a small lathe will keep the gears for stud and screw exactly in line so there will be no mistake. If the marker is left alone, it will also show at a glance what gears were used last. With turning gears in the lathe, the marker could be pushed to the top of the plate.

When making the marker, bend the ends over at just the right width to snap over the index plate with a slight spring action as shown at the right.—B. K.

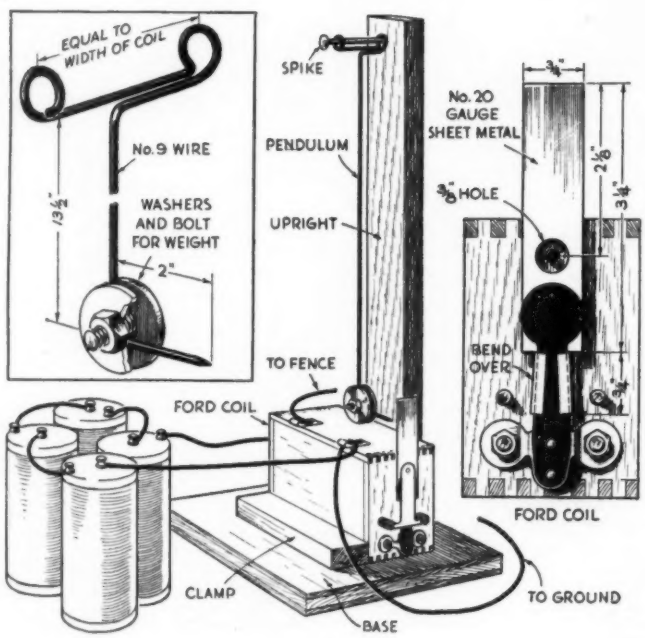


High-Voltage FENCE for FARM STOCK

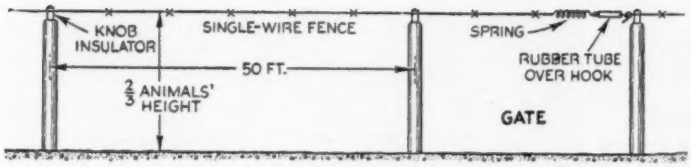
FOR the efficient, economical, and safe control of an electric stock fence, an old model-T Ford spark coil has been found well adapted by a number of farmers in the Middle West. However, to allow an animal to recover from the shock and step away from the wire, the coil must be modified to make and break the circuit at intervals of about one second.

An easy way to accomplish this is by using a pendulum. Each time it swings, it brings the coil points together and causes a high-voltage charge to surge through the fence wire. At the same time, the inner coil point is drawn sharply back by magnetic attraction, and this gives the pendulum a flip in the opposite direction, so that the operation repeats itself with clocklike regularity.

Materials: 1 model-T Ford coil; 3 old "B" battery clips; 1 pc. sheet iron ¾" by 4"; from 1 to 4 dry cells or a 6-volt storage battery; 30" of No. 9 iron wire; 1



How the pendulum is made, how the inner coil point is extended with a piece of sheet metal, and how the whole device is set up



Typical fence. At the gate the wire is held with a hook, which may be unfastened by using rubber tubing or by standing on a dry board

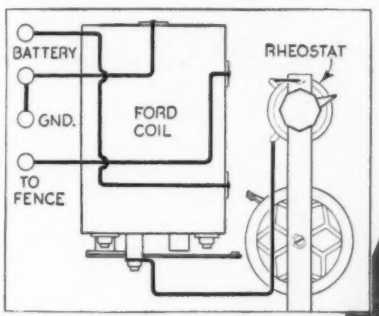
spike, 1 machine bolt ¾" long, 2 iron washers, and a few small nails; 5' insulated battery wire; 1 knob insulator for each post 50' apart; 1 pine or plywood base 1" by 8" by 12"; 1 pine clamp 1" by 1" by 6"; 1 pine upright 1" by 2" by 24"; and the necessary fence wire.

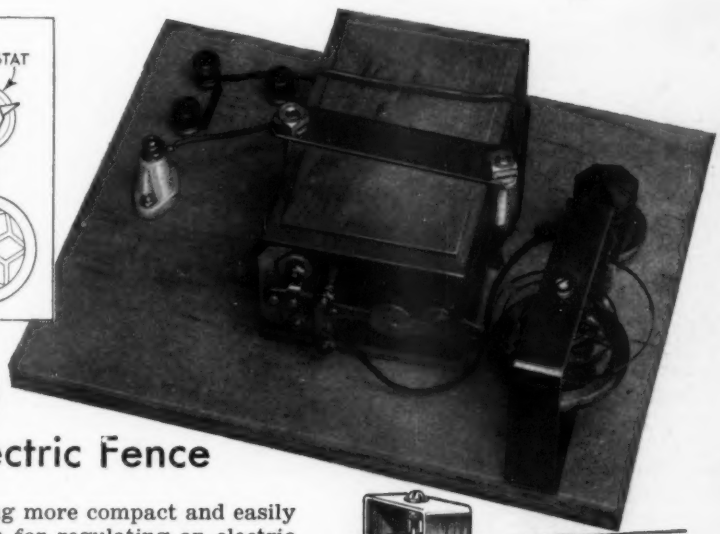
To alter the coil, simply remove the points and extend the inner one by clamping on a piece of sheet iron. Replace the outer point, but do not tighten it so that it is in contact with the inner one. Solder old battery clips to the coil posts.

Now mount the coil as shown and add an upright to support the pendulum, which is bent from wire. File the end to a sharp point and bolt on the two washers. Drive a spike to support the pendulum so it clears the coil by about 1".

The fence wire must be well insulated and about two thirds the height of the animals from the ground. In some cases, as when there are hogs and horses in the same field, it may be necessary to use two wires. It is best to make a complete circle with the wire; then if it breaks in one place, all the fence is still effective. To test, stick one end of an iron rod in the ground and bring the other end near the wire. No spark indicates that the wire is broken or grounded.

Before being turned into the field, the stock should be trained in a small lot with an electric fence wire around it. Then they will respect the "hot" wire.—W. A. HARRIMAN.





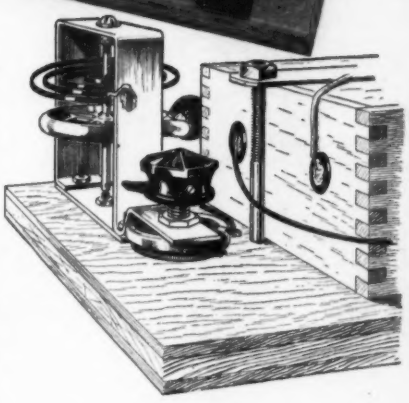
Balance Wheel Controls Electric Fence

THOSE who wish something more compact and easily adjusted than a pendulum for regulating an electric fence can construct a balance-wheel control.

The outer point of the model-T Ford coil is removed, and the inner one extended so as to reach out over the edge of the coil. This is done by cutting off part of another point and soldering it to the regular one. Note that this contact is turned to face the opposite way from the original one.

Any heavy wheel about 2" in diameter will serve for the balance wheel. The one shown is a lead wheel taken from a gyroscopic toy. The contact taken from the outer coil point is soldered to one side of the wheel. The spring, which acts like the hairspring of a watch, may be the mainspring from a watch. The weaker the spring, the slower the wheel will swing.

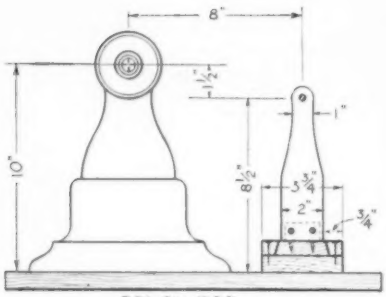
Mounted below the wheel is a 3-ohm radio rheostat. By adjusting it, the wheel can be made to swing no farther than necessary.—FRANK M. SHOEMAKER.

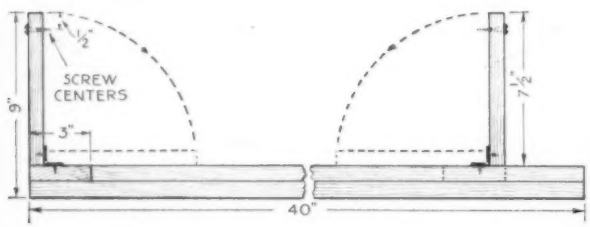


When the two contacts come together, the magnet attracts the coil point and this, in turns, snaps the wheel around

Jig Holds Wood Turning To Be Copied

One arm of the jig is hinged and slides in the base so that work of any size may easily be held just in back of the lathe





PLACED to the rear of the lathe, this jig is convenient for holding an original turning when duplicates must be made. For a lathe that has a capacity of 36" between centers, cut a baseboard ¾" by 3¾" by 40". Band saw the two supports to the general contour shown and fasten one of them to a base block ¾" by 3" by 3¾" by means of a 1½" by 2" fast-pin butt hinge. Nail the block to one end of the board.

For the guides, rip two pieces ¾" by ¾" by 37". Then set your saw table at a 70-deg. pitch and run these pieces through again to obtain the proper bevel. Nail them to the baseboard, flush with the edge and with the beveled side in.

While your saw is still at an angle, cut the sliding base for the adjustable support. This piece is ¾" thick, 3" long, and beveled on both edges to slide freely between the guides. Hinge it to the remaining support.

Drill a ⅛" hole ½" from the top of each support for a 1" No. 10 roundhead screw that has been ground to a blunt point. Fasten the jig in rear of the lathe so that the screw pin of the left arm is even with the pin in the lathe spur center.—FRANK HEGEMEYER.

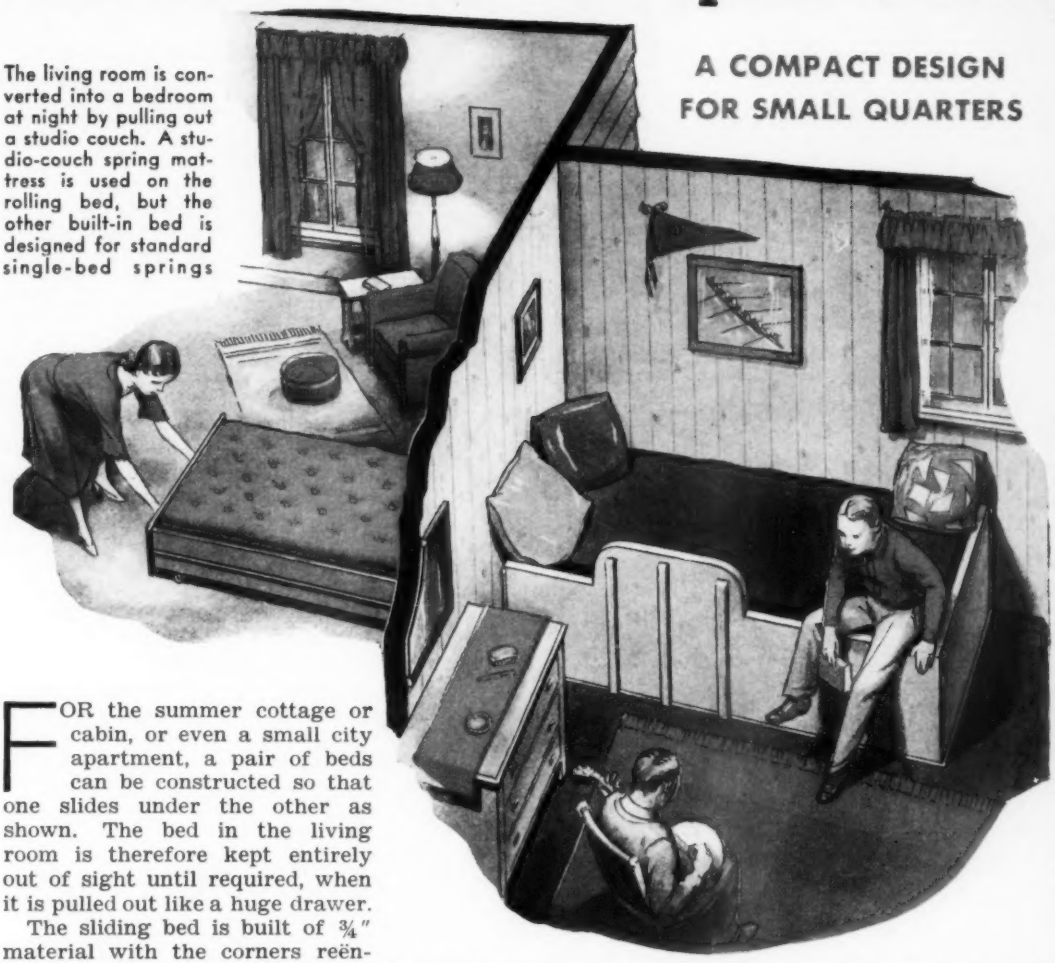
Darkroom Paper Container Made from Letter File

AN ORDINARY box-type letter file can be converted into a light-tight paper container for use in the darkroom. Cut a piece of heavy cardboard for the front of the box and hold in place with gummed tape. The cover will then come down on all sides, overlapping about 1". A piece of adhesive tape should be used to reënforce the hinge of the lid and keep out light from that point. This should be sufficient, but extra precautions may be taken by lining the box with black paper.—CURTIS MCDOWELL.

Two Beds Built in the Space of One

A COMPACT DESIGN FOR SMALL QUARTERS

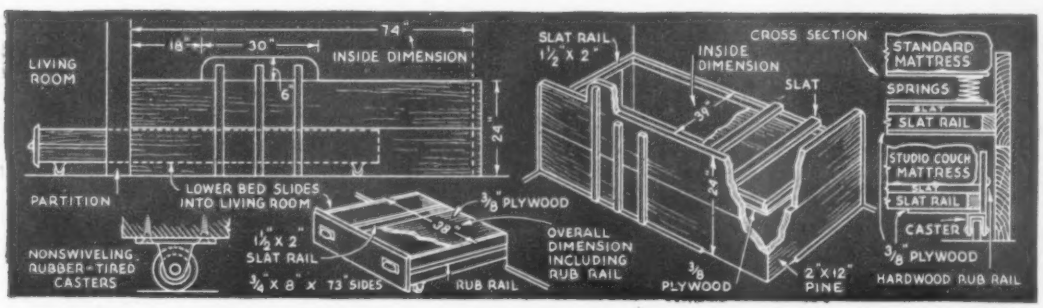
The living room is converted into a bedroom at night by pulling out a studio couch. A studio-couch spring mattress is used on the rolling bed, but the other built-in bed is designed for standard single-bed springs



FOR the summer cottage or cabin, or even a small city apartment, a pair of beds can be constructed so that one slides under the other as shown. The bed in the living room is therefore kept entirely out of sight until required, when it is pulled out like a huge drawer.

The sliding bed is built of ¾" material with the corners reënforced by angle brackets, and a panel of ⅜" plywood is nailed under the slat rails. The heavy slat rails are screwed and glued to the side members. Nonswivel, rubber-tired casters are mounted under the slat rails, and a half-round, hardwood rubbing strip protects the sides. The front end overlaps the opening.

The stationary bed in the adjoining room requires thicker material for the boxlike frame, the corners being mitered. A plywood bottom prevents dust falling to the studio couch below. The upper bed is designed for standard single-bed springs, the lower one for a narrower studio-couch spring mattress.



Modern Piano Bench

HOLDS LARGE FILE OF MUSIC

Music kept in the twin compartments is always within reach of the player without having to move from the bench or stoop far over. At right, how the chest is assembled

By
D. C.
MARSHALL

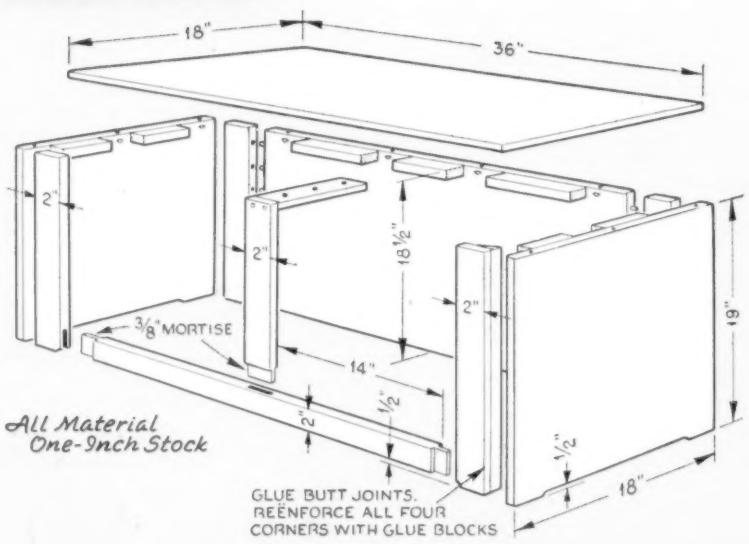
•

ALTHOUGH seemingly neglected by designers of modern furniture, the piano bench may be brought into harmony with the new streamline trend by constructing it in the form of a plain, round-cornered chest. It then also provides an up-to-date method of storing music.

Glue up the pieces for the ends, and glue a piece at right angles on the edge of each as shown to form the corners. Back up each corner joint with a glue block. Next prepare the top, back panel, and front stretcher. The back panel is doweled to the corner strips, and the stretcher is mortised into the front corners.

The top may be fastened in various ways. It may be screwed on from underneath through blocks glued and screwed to the chest, or secured with regular table-top fasteners or angle irons. The simplest method, however, is to nail or screw it down from the top, and either fill the nail holes or apply plugs over the heads of the screws. In any case, all corners around the top should be well backed with glue blocks.

The fronts for the music compart-



ments are glued up, and the corners rabbeted to receive the sides, which are narrower at the bottom so as to give a hopper shape to each compartment. This has the advantage of providing more room at the top to separate the pieces of music when looking through them. The bottom is nailed in when the sides are attached. The back of each compartment is made of plywood and set in grooves in the ends, but not inserted until the boxes have been hinged. Continuous piano hinges are the best type to use.

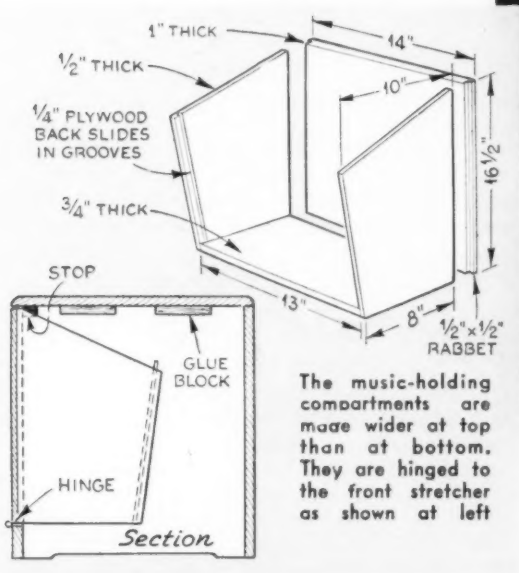
After the boxes are hinged, turn the chest bottom up so the backs can be put in the music compartments. These must be left to the last because they also serve as stops to prevent the boxes from swinging clear out when tilted forward.

Rounding the corners is the next job. If the stock is all 1″ thick, there will be ample wood for this purpose. Most of the surplus can be cut off with a plane or spokeshave, and the finishing can be done with a sanding disk or drum on a flexible shaft, or by hand.

The finish should match the piano*. If of the rubbed varnish or lacquer type, a polishing pad on the flexible shaft will save a lot of elbow grease in rubbing it down. Finally, add a suitable handle for each compartment.

If desired, large filing cards may be used. It is then much easier to find a piece than by the old method of hunting through a pile of sheets stacked in the shallow box of an old-style bench.

*For complete instructions on finishing fine furniture, refer to "Amateur Craftsman's Cyclopedia," Chapter VI (Popular Science Publishing Co., Inc., New York, price $3.50).



The music-holding compartments are made wider at top than at bottom. They are hinged to the front stretcher as shown at left

Gluing Up Wide Boards for Use in Furniture

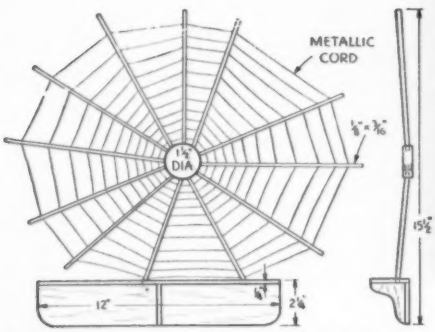
WHEN a wide surface is required in constructing furniture, several narrower boards must be glued edge to edge. It is not, in fact, a good plan to use too wide boards, even if available, because they are more likely to warp or crack.

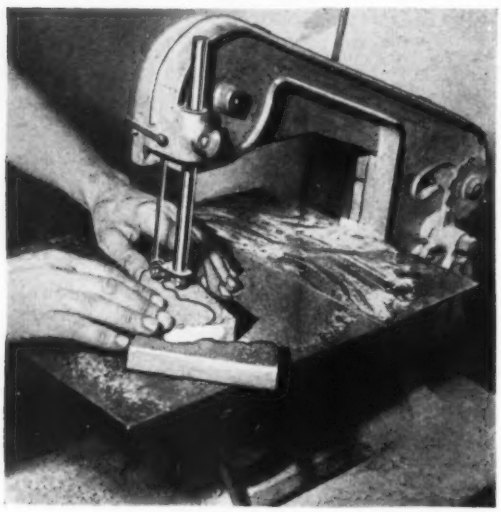
Arrange the boards side by side on the bench so that the grain figure appears to best advantage. If possible, place them so that the entire finished surface can be planed in one direction without tearing up the grain. Mark or number them for identification.

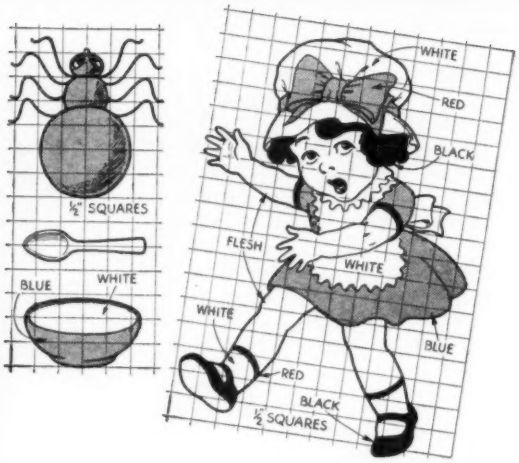
Plane the edges of two boards at once by clamping them face to face with two hand screws. Separate them and test the joint by placing one board on top of the other and looking towards the light. A little light may show in the middle, but the ends must be tight. When the boards are glued up, plane them first across the grain, then finish along the grain with plane and scrapers.

A polishing pad on a flexible shaft, if available, will save labor in rubbing down a varnish or lacquer finish

NOVEL THREAD RACK DEPICTS Little Miss Muffet







Left, sawing the spider; above, the patterns; at top, the finished rack. The web is of metallic cord, and the spokes may be painted various colors

BECAUSE of its appeal to childhood memories, this "Little Miss Muffet" thread rack is a gift novelty of a unique and attractive type. The shelf, Miss Muffet, and her bowl are cut from ¼" plywood. The web consists of a center block bored to take twelve small sticks of varying lengths, around which some metallic gift-wrapping cord is wound. The spider is shaped from ¾" thick insulating wall board or other soft material and dipped in black paint. The back part of the body is left thick to serve as a pincushion. The legs are black wire.

Two spokes of the web are set into holes in the top of the shelf, and Miss Muffet is fastened to the shelf with small screws or nails. A single nail secures the spider to the center block of the web. The bowl and spoon may be cemented on, or the bowl fastened with very small brads.—D. C. M.

Liquid Solder Protects Tape

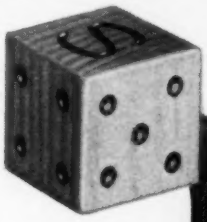
IN WRAPPING split or weak ax and sledge hammer handles, baseball bats, and the like with friction tape, I have found that the repair can be made more effective by applying two coats of liquid solder over the tape. These are allowed to dry successively, then a coat of shellac is brushed on. The film seems to render the tape more resistant to acid fumes, heat, and moisture.—LESTER S. HOUTZ.

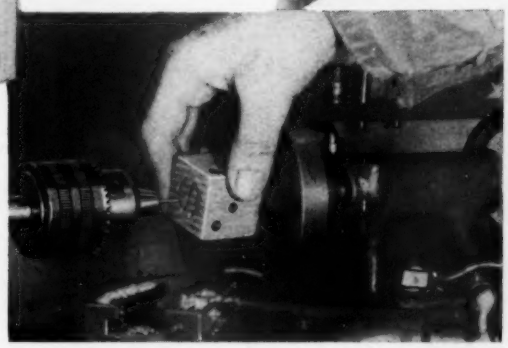
Salt and Pepper Shakers Resemble Giant Dice

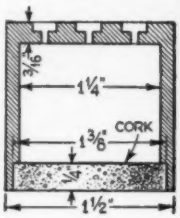
MADE in the form of giant dice, wooden salt and pepper shakers are a novelty for the table. Use blocks of maple or other hardwood 1½″ by 1½″ by 1½″. The work may be trued up square before boring if care is taken to prevent the chuck jaws from marring the blocks.

First bore a 1¼″ hole 1 5/16″ deep; then counterbore to a diameter of 1⅜″ for ¼″ to form a seat for the flat cork. Finish truing the blocks, if not done before, and carefully mark off the spots with a pencil. Drawing diagonal lines on each side will help. Be certain that the spots on opposite sides add up to seven. Round the end of a ¼″ metal rod and insert the other end in a piece of scrap wood for a handle. Heat this tool red hot and burn each spot. Draw the initals on top and burn with pieces of stiff wire. Drill holes in the letters, using a 1/16″ drill for salt and a 3/64″ drill for pepper. Space the holes about ¼″ apart. Cut two notches in opposite corners of the bottom for removing the cork.

Right, burning in the spots. Below, a metal lathe, if available, is an aid







Use any clear finish, leaving the spots a burned black, or paint the shakers and markings with bright, contrasting colors.—B. K.

PUTTY for GLAZING and CRACK FILLING [*PAINTING*]

Instead of ordinary whiting-and-oil putty, it is better to use a lead-base putty for glazing and for filling blemishes in painted work. The ingredients:

1 part dry white lead or soft paste lead

2 parts dry whiting

Blend carefully and smoothly together. This may be used to fill nail holes, bruises, etc., if dry colors are added as necessary to match. Keep soft with gold-size japan. Use a flexible putty knife to tool the putty firmly in place. Allow to dry hard, then sandpaper level.

To prepare a crack filler or cold-water putty, the following may be used:

12 oz. dental plaster of Paris

3 oz. yellow (canary) dextrin

1 oz. dry French ocher or other dry color

Mix thoroughly, then work up only enough of this with water for immediate use.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Saw-Table Fixtures Hang Conveniently on Overhead Rack

WHEN a circular saw is placed in the center of a home workshop, many steps may be saved by constructing a hanging rack as shown for holding the miter gauge, push stick, and other accessories. It consists of two vertical pieces nailed to a floor joist above or to any convenient support, and a crosspiece, and can be made from scrap lumber. The rack should hang about a foot to the right of the saw blade and about three feet above the table for the average-size man.

Bolts for Model Work

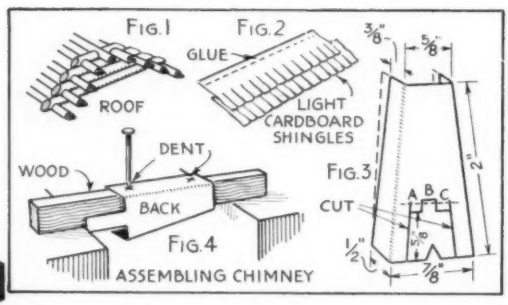
IF IT is necessary to simulate hexagonal or square bolts in model work, escutcheon pins can be used, and the heads filed to shape. Should miniature machine bolts be needed, do the threading first so the vise jaws will not injure the heads in any way.

Miniature Log Cabin Built for Burning Incense

SMOKE curls realistically from the chimney of this miniature log cabin, because it is really an incense burner. It is made from safety matches and scraps of materials on a plywood base 2½" by 3".

Cut and bend the chimney from two pieces of tin about 1⅞" by 2". The outer part of the chimney is made as in Fig. 3, but the back must have a sort of tail, as indicated in Fig. 4, which shows how the two parts are joined. The "tail" is then bent back and up against the inside of the cabin wall. A shallow depression in the base, floored with tin, helps make the chimney more rigid.

Add a cardboard cabin door with cloth hinges and a window pane of wax paper with painted bars. Putty any chinks, shellac the whole, paint the base green, and color the chimney stones gray and brown. There is no danger that the cabin will catch fire provided the chimney is given a chance to cool off each time incense is burned.—R. J. MAURO.

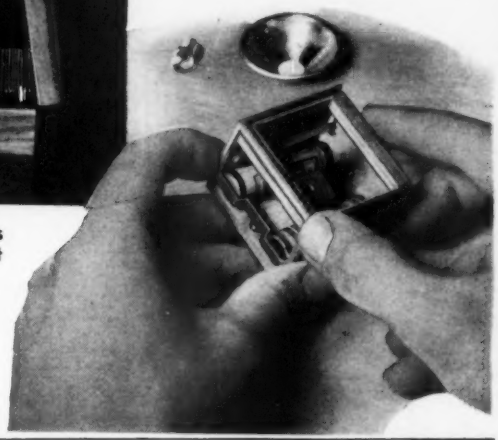


Left, the cabin. Above, how the match sticks are notched and glued together, how the cardboard roof is laid, and how the chimney is made

Illuminated Viewer

FOR COLORED PHOTO SLIDES

When a Kodachrome slide is set on the viewer, its weight closes a switch, which turns on the light



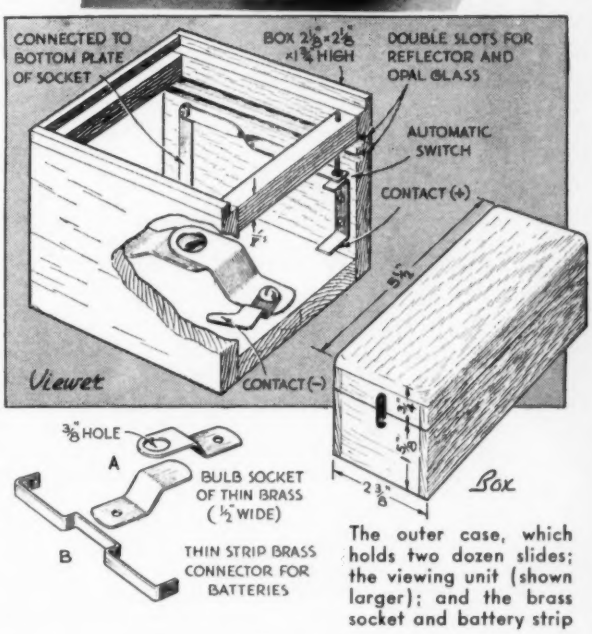
AFTER I had several Kodachrome slides broken by friends while viewing them, I devised the following method to protect them:

A small box was glued together from ⅛" thick cigar-box wood as shown, the cover was cut off 1⅝" from the bottom, small hinges were fastened at one end, and a small hook was attached to the other or front end.

The second unit is an illuminated viewer with an automatic switch. This box is also made from cigar-box wood. Strips of 1/16" square wood are glued around the top on three sides, leaving the right side open so that a Kodachrome slide can be placed there.

A simple socket is made from thin brass as at *A* to hold a small flash-light bulb. Small pencil flash-light batteries are placed on each side of it at the bottom of the viewer. They are held and also connected together by a piece of brass shaped as at *B*. The top part of the socket is connected to one battery by a small piece of spring brass, and the bottom part is connected to the opposite end of the other battery in the same manner except for a switch, which is merely an overlapping break in the strip of brass. A small nail, which fits loosely in a hole through one of the wooden stringers, brings the two pieces of brass together by the weight of the slide.

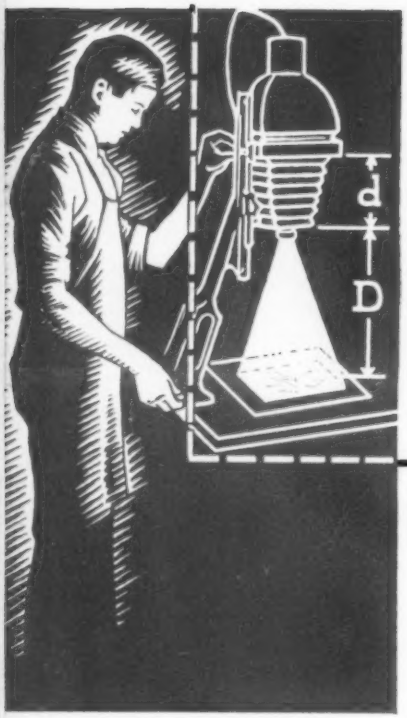
Two parallel slots 1/16" apart are cut on the inside faces of the front and the back of the viewer right under the stringers. The bottom slot is for a flash-light reflector to slide into. If the reflector is too small, solder lugs on each side to make it fit. A thin piece of opal glass is cut to slide into the top slot. A coat of shellac followed by a coat of varnish completes the viewer.—FRANK MCCARTY.



The outer case, which holds two dozen slides; the viewing unit (shown larger); and the brass socket and battery strip

Now..PHOTO DATA

ENLARGING — BASIC DIMENSIONS [PHOTOGRAPHY]



To find dimensions other than in the table below, let D equal the distance in inches from lens to paper; d, the distance from negative to lens: r, the amount of enlargement, as twice, three times, etc.; and f, the focal length of the lens in inches. Then $D=(r+1)f$. To find distance d, simply divide D by r.

AMOUNT OF ENLARGEMENT (r)	FOCAL LENGTH OF LENS IN INCHES (f)							
	2"		3"		4"		5"	
	D	d	D	d	D	d	D	d
TWICE	6	3	9	4½	12	6	15	7½
3 TIMES	8	2⅔	12	4	16	5⅓	20	6⅔
4 "	10	2½	15	3¾	20	5	25	6¼
5 "	12	2⅖	18	3⅗	24	4⅘	30	6
6 "	14	2⅓	21	3½	28	4⅔	35	5⅚

POPULAR SCIENCE MONTHLY SHOP DATA FILE

SO GREAT has been the success of the Popular Science Monthly Shop Data File that we are extending this special service to cover the subject of amateur photography. Formulas, tabulations, and general information will be presented from month to month in the same general form as the four topics on these pages—that is, arranged as if on 3″ by 5″ file cards. Readers who save this data will find in time that they have a tabloid course in amateur photography, covering all the fundamentals.

NEGATIVES LACKING SHARPNESS [PHOTOGRAPHY]

1. A common cause is a dirty lens. Don't touch glass with fingers. Keep lens covered when not in use. Remove large bits of dirt, grit, etc., with soft camel's-hair brush. Then wipe *lightly* and circularly with special lens tissue paper or a well-laundered cotton or silk handkerchief. In extreme cases use a prepared lens-cleaning solution or a drop of xylol (xylene)—never water or other liquid.

2. Stray light, generally caused by pointing camera towards source. Use a lens shade, which makes any picture sharper.

3. Camera movement. Use tripod or other support for shutter speeds slower than 1/25 second.

4. Out of focus. Amateurs using fixed-focus cameras are inclined to stand too close to the subject when making portraits, etc. Find minimum distance for your camera, and don't get closer.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

In Ready-Reference Form

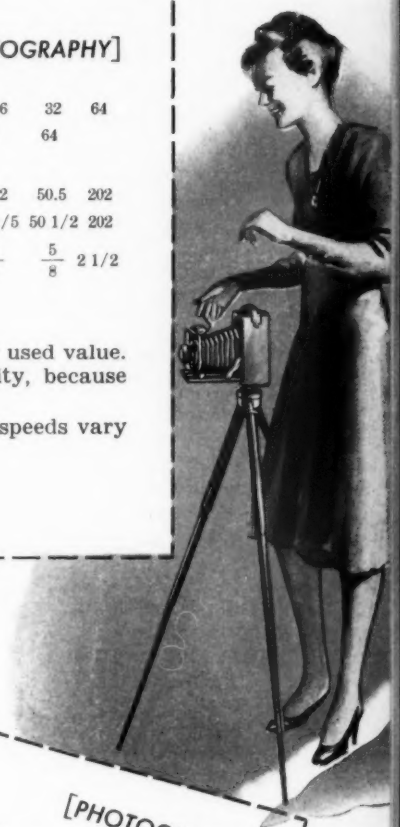
RELATIVE SPEEDS OF LENS STOPS

[PHOTOGRAPHY]

F value	1.5	2	2.8	3.5	4	4.5	5.6	6.3	8	11	11.3	16	22	22.6	32	64
U. S. value					1		2		4		8	16		32	64	
Relative Exposures Decimal	.111	.20	.40	.60	.80	1.0	1.55	2.0	3.15	5.97	6.30	12.5	24	25.2	50.5	202
Fraction	1/9	1/5	2/5	3/5	4/5	1	1 1/2	2	3 1/7	6	6 1/3	12 1/2	24	25 1/5	50 1/2	202
Seconds	1/720	1/400	1/200	1/135	1/100	1/80	1/50	1/40	1/25	1/13	1/12	1/6	1/3	1/3	5/8	2 1/2

"U.S." means "Uniform System."
Seconds exposure is calculated on basis of 1/25 at F/8, a commonly used value.
Fractional and decimal values are calculated with F/4.5 as unity, because that is lens stop often compared with others.
To figure other examples, merely remember that the relative lens speeds vary as the squares of the F values.

POPULAR SCIENCE MONTHLY SHOP DATA FILE



PERCENTAGE SOLUTIONS

[PHOTOGRAPHY]

To make 28% acetic acid from glacial acetic acid, take 8 parts water, 3 parts acid.

To make 10% potassium bromide solution by metric system, dissolve 10 grams of crystalline potassium bromide in 100 cc. of water.

To make a 10% solution by avoirdupois system, dissolve 1 ounce (437½ grains) of the salt in 9⅛ oz. (9 oz., 1 fluid dram) of water. This gives a solution containing about 10 gr. of salt to 100 minims of water. Note: A common error is to dissolve 1 oz. solid in 10 oz. water. This is *not* a 10% solution, but only about 9.1%.

For a 1% solution, use 1/10 as much solid as given above, and same quantity of water. Figure other percentages in proportion.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

New series will give fundamentals of picture taking, developing, printing, and enlarging

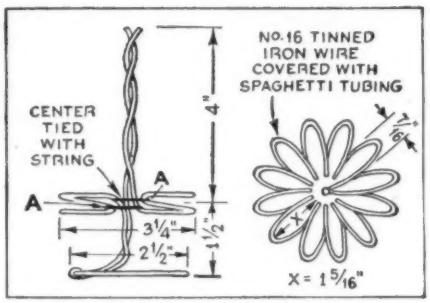
Films Held in Wire Rack

FOR TANK DEVELOPMENT

MANY of the advantages of a developing tank are obtained by making a film rack from a length of No. 16 tinned iron wire as shown. The wire is covered before being bent with spaghetti insulation such as is used in radio construction. The dimensions given are for a rack to hold twelve 2¼" by 3¼" films, but they may be readily changed. A 600-cc. glass beaker forms an inexpensive "tank."

When the rack has been bent to shape, the centers are tied with string in two rows as shown at *A*. Any joints or breaks in the spaghetti tubing are coated with celluloid cement and allowed to dry. Two coats of model airplane dope are then applied carefully to the entire rack.—AMOS SCOTT.

Each film is bent lengthwise, emulsion side in, and placed in a loop of the rack, which is shaped as shown at right



Rubber Bands Steady Tray

WHEN a small developing tray is placed in a larger one so that the latter may be supplied with running water in order to cool the developer, two rubber bands will prevent the smaller tray from floating about and tipping. Snap the bands in place close to the edges of the small tray as shown above. They will not then interfere with the manipulation of the films.—W. K.

Protecting Finger Nails from Photo Stains

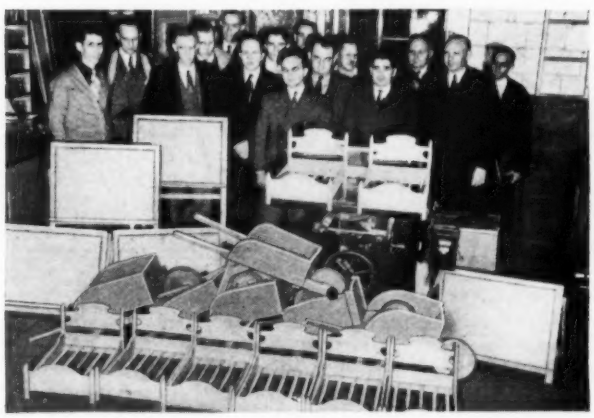
TO PREVENT any of the chemicals used in the darkroom, such as amidol photographic developer, from staining the finger nails, take the precaution to apply quick-drying lacquer to the nail surfaces. Any color will do, although clear is probably best because it is not unsightly if not removed immediately after the work is finished. Spraying lacquer is good, when available, because it dries more quickly than the brushing type. Lacquer nail polishes also can be used. To remove the lacquer, use the thinner or remover designed for it.

Official Magazine
POPULAR SCIENCE MONTHLY

Lucile Thornton, assistant in the radio studio at the University of Kentucky, with toys made for distribution at eight remote radio centers

Lexington Homecrafters Bring Joy to Children of Kentucky

TWENTY members of the ***Lexington (Ky.)*** Homecrafters recently returned from a trip into the Cumberland Mountains where 500 toys were distributed to poor children at eight "radio listening centers" maintained by the University of Kentucky. The men went only as far as the first center because travel from there on had to be done on horseback. Elmer G. Sulzer, director of radio and publicity at the University, and Miss Corsia Whitaker, listening-center supervisor, completed the journey, covering six counties in the eastern part of the state.



Some of the toys made by the Hi-Way Homeworkshop Club, Ames, Iowa. Carefully planned production methods were used

The making of toys was begun by the club five years ago, and during that time the members have sent more than 2,000 to the mountain children. Approximately fifty business and professional men of Lexington belong to the club, and the toys they produce are of the highest quality. Included in this year's assortment were toy furniture, trick ladders, baseball bats, wagons, trains, autos, cradles, boxes of blocks, ironing boards, wagging dogs, and other toy animals.

Projects such as this are undertaken by nearly all the home workshop clubs affiliated with the National Homeworkshop Guild. Most of the work is done during the few

Members of the Cornwall (Ont., Canada) Homeworkshop Club at work in a school shop. Left, a window exhibition held by the club

months before Christmas, but some clubs make toys throughout the entire year and distribute them whenever a worthy cause appears.

Here is what a few of the clubs have done: ***Helena (Ark.)*** Homeworkshop Guild made 500 wooden wheels for the P.W.A. Toy Shop. In addition, one member, H. D. Robinson, made 2,000 toys by himself. ***Portland (Ore.)*** Homeworkshop Club donated approximately 1,000 toys to the Toy and Joy Makers, a branch of the local fire department. Toys made by the ***Niles (Calif.)*** Homeworkshop Guild were distributed through the Alameda County Welfare Board. Nearly 100 toy ducks, doll beds, wheelbarrows, and sleighs were given to poor children by the ***Preston (Ont., Canada)*** Homecraft Club. The Capital Homecraft Club, ***Washington, D. C.,*** assisted various charity organizations in repairing toys. Toys to the number of 4,182 were made by the Homecraftsmen's Club of ***Long Beach, Calif.,*** and given to the Christmas Cheer Fund of a local newspaper.

Among the clubs to join the Guild recently is the ***Humacao (Puerto Rico)*** Homeworkshop Club. At the organization meeting sixteen members joined. Speakers were Casimiro Olmedo Leduc, representing a local lumber company, and M. Mediavilla, manual training teacher, both of whom promised coöperation.

The ***Vicksburg (Miss.)*** Homeworkshop Club is considering the purchase of tools which will be rented to the members. Moving pictures on the subjects of lathes and abrasives were shown at recent meetings, and T. E. Stepan demonstrated how to cut dovetail joints on a drill press.

Lumber and its care was a topic discussed by the Tri-City Homeworkshop Club at the home of Kenneth May, ***Peru, Ill.*** . . . When the ***Leroy (N.Y.)*** Homeworkshop Club held a party recently, each member had to provide a gift for another member. Robert H. Howard spoke on "The Application of Geometry and Mechanical Drawing to Shop Work" at one meeting. . . . Old furniture is being repaired and refinished by the ***Plymouth (Mass.)*** Homeworkshop Club for its clubroom. . . . A new workshop 20′ by 35′ has been built by the ***Beach (Va.)*** Workshop Club. Wall lockers were made for each member. . . . The Kerrisdale Homeworkshop

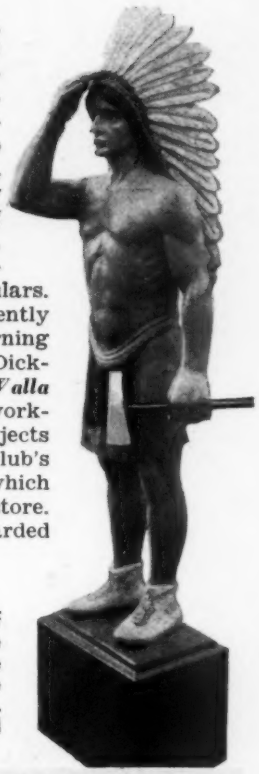
Club, *Vancouver, B.C., Canada*, held a social to which the wives of the members were invited.

A series of excellent talks has been given before the Hi-Way Homeworkshop Club, *Ames, Iowa*, including the following: "Home Workshops" by J. E. Harlan, "Manufacture of Paints and Varnishes" by Ed Steinhoff, "Uses of Keene Cement in the Workshop" by J. A. Busby, and "Workshop Kinks" by Leland Benz.

About half the membership of the *Lincoln (Nebr.)* Homeworkshop Club has taken up archery and is making bows, arrows, and targets. Another group is studying wood carving, while a third group is making furniture. . . . Lamps are being made by the *Onaway (Mich.)* Wood Carvers. . . . E. Sanderson and R. Baer, of the Bison Builders Guild, *Buffalo, N.Y.*, arranged a special display for a department store window. . . . Craftwork exhibited in a *Hartford (Conn.)* window by the Nutmeggers Homeworkshop Club aroused a great deal of interest, and many inquiries were received about joining the group.

The following clubs are scheduled to hold exhibitions sometime in March or April: *Peekskill (N.Y.)* Homeworkshop Club, *Onaway (Mich.)* Wood Carvers, *Seattle (Wash.)* Homeworkshop Club, *Preston (Ont., Canada)* Homecraft Club, *Edmundston (N.B., Canada)* Hobbyists, Lewis-Clark Homeworkshop Club of *Lewiston, Idaho*, and Community Craftsman's Guild of *Montreal, P.Q., Canada.* Watch local newspapers for further particulars.

Frank Sanders recently demonstrated metal turning at the home of Percy Dickerson before the *Walla Walla (Wash.)* Homeworkshop Club. Fifty projects were displayed in the club's craftwork exhibition, which was held in a vacant store. John Linker was awarded the grand prize.



Four-foot-high figure of an Indian carved from pine in a month's leisure time by A. O. Stenwick, of the Red Wing (Minn.) Club. It is realistically painted

Many Clubs Celebrate the Guild's Fifth Birthday

DINNERS, parties, and special meetings were arranged by many clubs affiliated with the National Homeworkshop Guild to mark its fifth birthday (see P. S. M., Dec. '38, p. 199).

Thirty members of the Ware (Mass.) Craftsman Guild attended a dinner held at their headquarters. President Albert M. Antaya and Secretary Stephen J. Milos spoke, and several members exhibited completed projects.

The Hardwood Homeworkshop Club celebrated the event with a party held in the Neenah (Wisc.) Armory. Wives and a number of friends attended.

A joint get-together and dinner was held by three Massachusetts clubs—South Shore Homeworkshop Club of Quincy, New Bedford Woodcraft Club, and Plymouth Homeworkshop Club. Herbert K. Bartlett was toastmaster.

Ware (Mass.) Craftsman Guild gathers for anniversary dinner

Other clubs holding anniversary dinners included the Peekskill (N.Y.) Homeworkshop Club and the Bison Builders Guild, Buffalo, N.Y. The Fall River (Mass.) Homecraft Club held open house, and the Bison Homeworkshop Guild, Buffalo, N.Y., gave a party at the home of Martin Bergen.

READERS RAID JUNK BOXES TO CREATE Goofy Birds

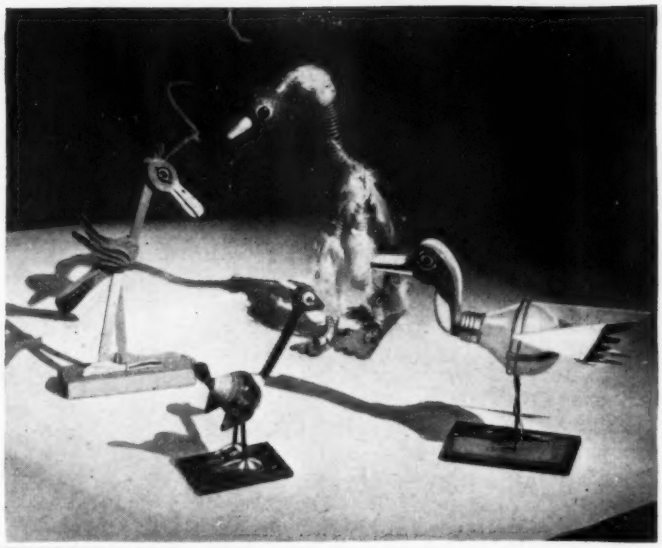
Fashioned from odds and ends, this bird carried off first honors

IMAGINATIVE authors sometimes describe weird birds and animals that might dwell upon other planets, but their wildest fantasies were surpassed by hundreds of readers who entered our goofy-bird contest (see P.S.M., Dec. '38, p. 167). Using all sorts of odds and ends found in junk boxes and around their homes, the contestants created fantastic birds that defy description. So varied were the entries that the judges found their task unusually difficult. Approximately fifty persons received honorable mention.

TWO NUTTY BIRDS WINS SPECIAL PRIZES

Among the entries were two birds that stood out because of their superior craftsmanship and artistic design. Although not goofy in the same sense as the other prize-winning entries, these birds received special $1 prizes. The "nutty" owl was made by Walter Clay and the long-legged bird by Eugene Hart

A ball of yarn is the body of this comical bird, winner of third prize. Left, as the ring is pulled, the bird tugs at the worm



Second prize went to the penguin cop at right, made from tin cans. Above are winners of $1 awards. Ice cream spoons and sticks were used for the bird at left, and spinning tops and a bit of flexible conduit form parts of the bird in front

Awards in Goofy-Bird Contest

FIRST PRIZE, $25

Thurman Stevenson, Friend, Nebr.

SECOND PRIZE, $15

Philip Armitage, Chatham, N.J.

THIRD PRIZE, $5

Marilyn Anne Prince, Carthage, N.Y.

$1 PRIZES

S. D. Ammon, Narvon, Pa.; Walter W. Clay, Columbus, Ohio; Lawrence W. Davis, Council Bluffs, Iowa; Ernest A. Floyd, Harriman, Tenn.; M. H. Hagen, Minneapolis, Minn.; Eugene S. Hart, Helena, Ark.; R. S. Mezza, Hebbronville, Texas.

HONORABLE MENTION

Henry Abramowitz, Binghamton, N.Y.; R. G. Bailey, Portland, Me.; Charles Bartos, Chicago, Ill.; Albert Buehl, Bronx, N.Y.; Betty Lou Bolt, Denver, Colo.; John W. Carson, Somerset, Ky.; Anthony C. Charewicz, Worcester, Mass.; Miss J. F. Christie, Valpariso, Fla.; Mrs. Ruth S. Craxtur, Cleveland, Ohio; Otto H. Engel, Davenport, Iowa; Harry Gustavsen, Swampscott, Mass.; Fred Halquist, South Bend, Ind.; R. Reid Harding, Bluefield, W.Va.; John W. Hawkins, Grand Junction, Colo.; Allen Hollingshead, Russiaville, Ind.; Norman Hopson, Oden, Ark.

Charles Jeglinski, New Bedford, Mass.; Henry P. Land, Jackson, Miss.; Mrs. Ida Levy, Bronx, N.Y.; J. C. Lewis, Legion, Texas; Robert S. Lipe, Manistee, Mich.; Kenneth Lloyd, Spokane, Wash.; Dick Longenecker, Davenport, Iowa; Mrs. Carol Lyman, Blanding, Utah; Mrs. William P. Lyon, Rochester, N.Y.; J. Madison, Toronto, Ont., Canada; Miss Mae C. Martner, Minneapolis, Minn.; Eldo Niehaus, Holland, Ind.; Mrs. Esther Perkins, Dover, N.H.; William Petersen, Hoboken, N.J.; Furcy Rodriguez, Brusly, La.; Herbert Schaper, Robbinsdale, Minn.; Joseph Selenak, Brooklyn, N.Y.

T. Springborn, Vancouver, B.C., Canada; W. B. Stanley, St. Paul, Minn.; Anne Stein, Cleveland, Ohio; Louis Stogsdill, Wichita, Kans.; Mabel E. Swartz, Winslow, Ark.; Theodore Torrison, Robbinsdale, Minn.; Pauline H. Vallier, N. Sacramento, Calif.; P. J. Van Vleet, York, Nebr.; Mrs. J. Wallis, Detroit, Mich.; Earl Weedman, Portland, Ore.; Mrs. Mary C. Wheeler, Valpariso, Fla.; Howell P. Williams, New Castle, Pa.; Walter Wismer, Chicago, Ill.; Miss Reeba Young, Seattle, Wash.

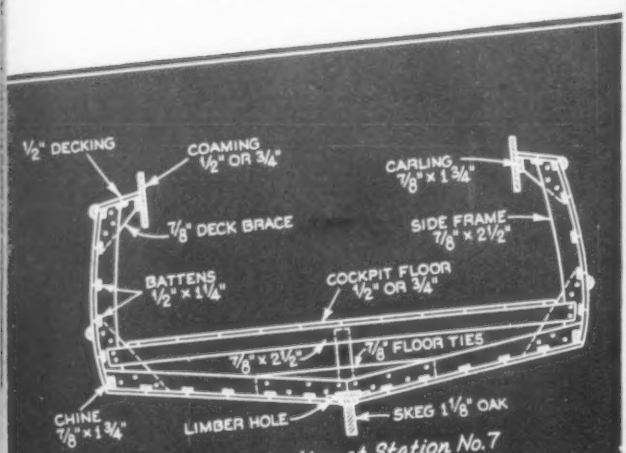
We Add the Cabin to Our

By WILLARD CRANDALL

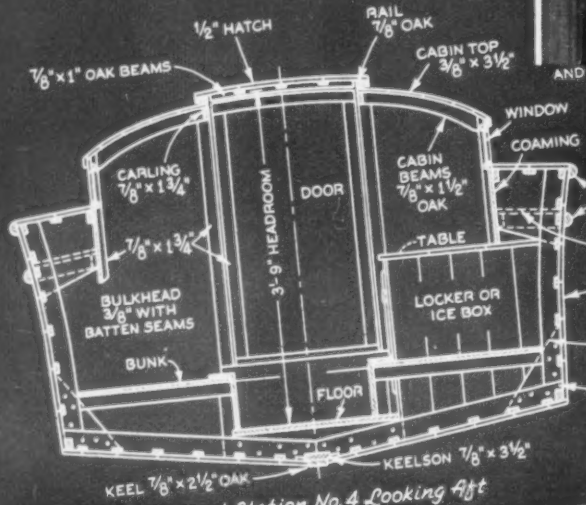
PART THREE

THE sheer and raised deck lines should be trued up and the end of each top plank cut to the shape shown in the previous assembly drawings of the cabin cruiser. Next, the small deck beams and braces that support the side deck should be cut to shape and screwed to the side frames. Make these straight on the top edge, as there is no curve to the side decks, but they must be ¾" higher where they join the carlings than at the sheer and raised deck. Now bend the carlings into position and fasten to the deck beams and braces; and also, with cleats, to the transom and to deck frame No. 1. The length of the deck braces and frames must be such that the carlings assume a true curve. (A study of the side and plan views in Part II will make this clearer.) A short deck beam cut to the curve of deck beam No. 1 is placed between the carlings at the front of the trunk

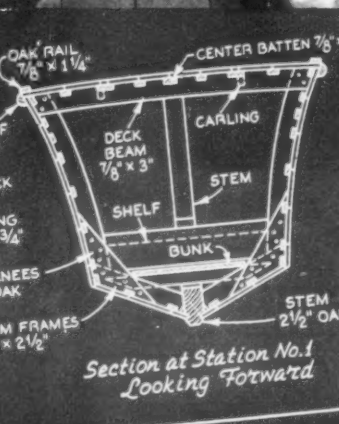
The cabin, shown in the insert, has ample space and headroom for comfortable cruising on long trips. Below, three sectional views



Section at Station No. 7



Section at Station No. 4 Looking Aft



Section at Station No. 1 Looking Forward

DESIGNED BY BRUCE N. CRANDALL
DR. BY - W.C. | TR. BY - A.S. | CHK'D. BY - J.W.
APPROVED BY - Arthur J. Darling, Home Workshop Editor

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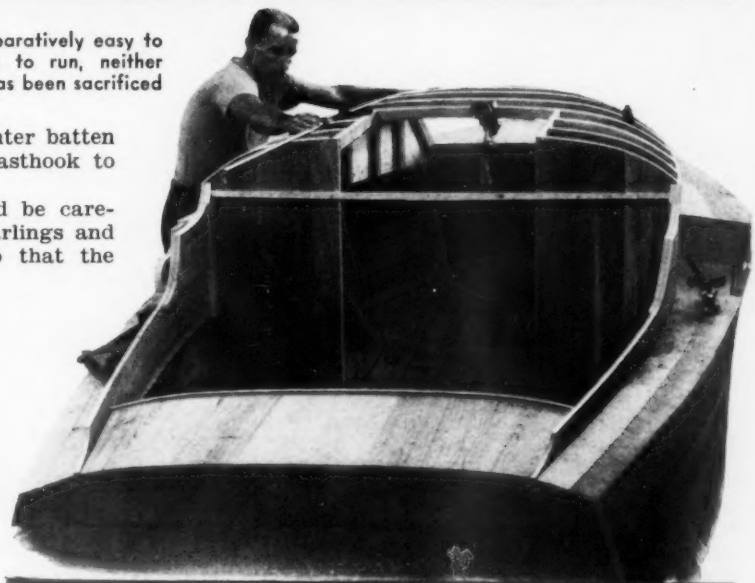
CABIN CRUISER
17 FT. LONG

Seventeen-Foot Cruiser

Although the boat is comparatively easy to construct and inexpensive to run, neither beauty nor seaworthiness has been sacrificed

cabin. A 7/8" by 1¾" center batten is installed from the breasthook to this deck frame.

The deck beams should be carefully trued up and the carlings and sheer battens beveled so that the decking will all fit perfectly, and with a true curve fore and aft. Install the deck battens as shown in the drawings; the decking will be laid with the seams over the battens. This will make it necessary to splice the side decking in several places so as to avoid wasting lumber. At each splice the planking should be screwed to butt blocks, which are coated with marine glue and installed between the battens. The deck seams, except those at the splices, should be cut to a V-shape and will be filled later with deck-seam compound. If the deck is to be canvas-covered, the decking may be all laid straight fore and aft.



A light batten is used to true up the cabin beams. This view also shows the double coaming behind cabin and how the side decks are laid

The coaming and cabin sides are next screwed to the carlings and then cut to the shape shown in the drawings. The coaming directly behind the cabin should be double, for extra strength. Uprights 7/8" by 1¾" will serve to strengthen the cabin sides and support the cabin beams, which are screwed to them.

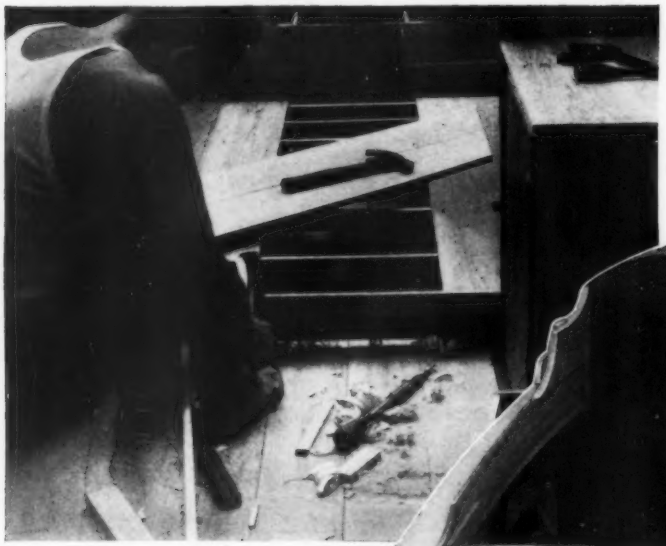
If the cabin beams are of oak, they need not be over 1" deep; this will add slightly to the headroom. The approximate curves of the cabin beams were shown in previous

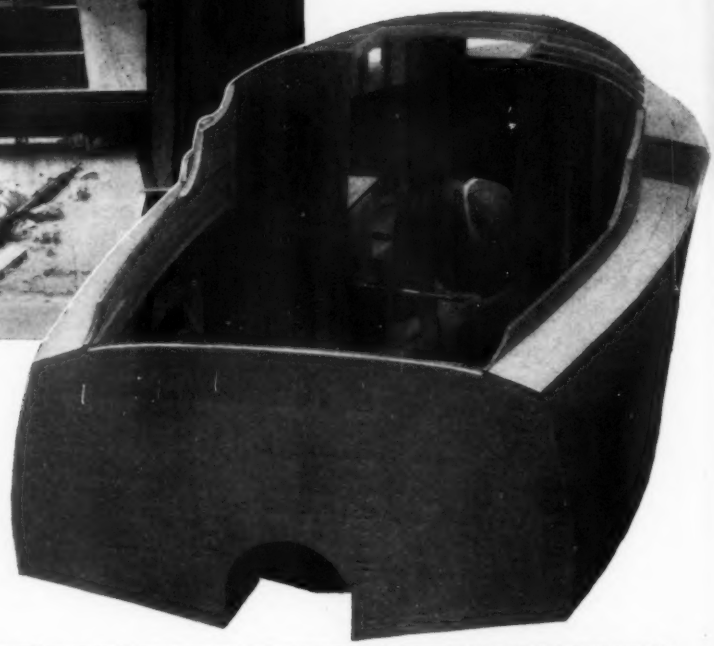
drawings, but their length should be determined by measuring between the cabin sides at the proper points as these measurements will vary with the individual boats. The cabin beams should be clamped in position and adjusted to obtain a true curve of the cabin top fore-and-aft before they are screwed in position. The cabin top should either be covered with canvas or of batten-seam construction with seams grooved and filled with seam composition.

The bulkhead and cabin door may be ⅜" planking with batten seams, plywood, or ½" tongue-and-groove. The bunks, cockpit, and cabin floor may all be made from the same material as the planking.

The cabin floor is laid directly on the floor ties, but the cockpit floor should be slightly higher and supported by separate beams. A section of it should be removable, so the bilge can be pumped out.

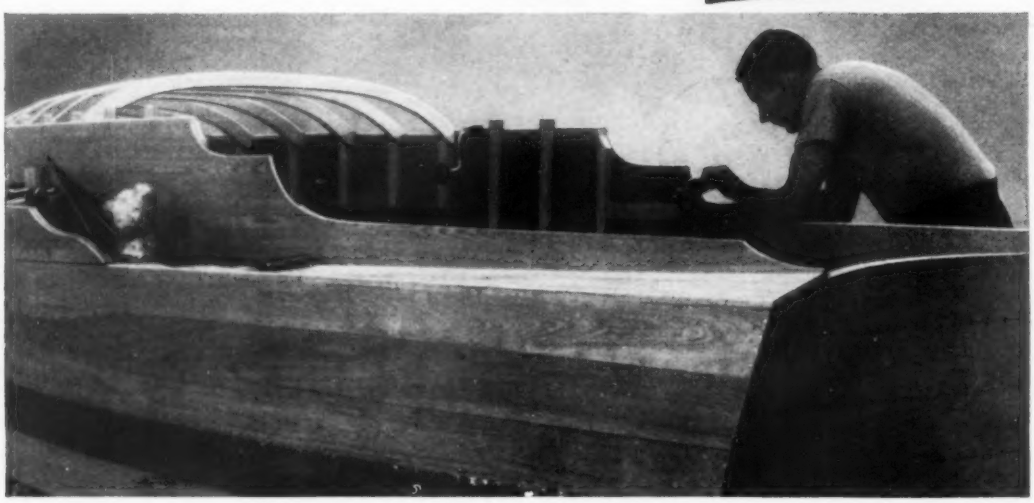
(TO BE CONCLUDED)





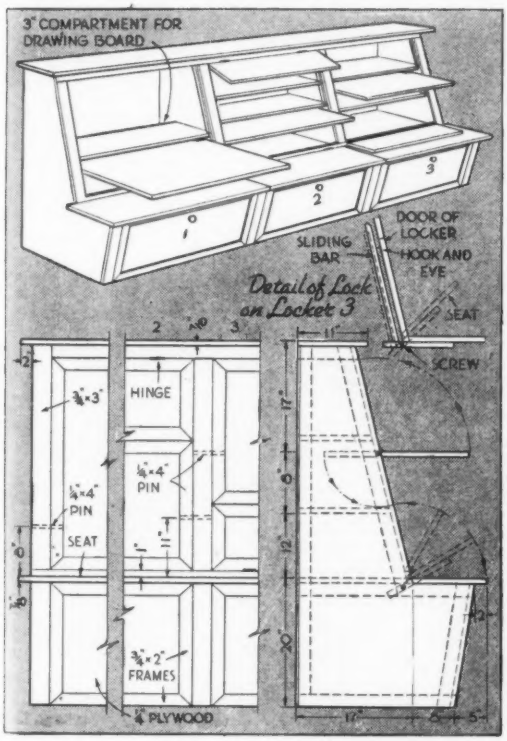
Cockpit and cabin floors may be of the same material as the planking. The cabin floor is laid directly on the floor ties, but the cockpit floor is raised on separate beams

Right, the cockpit seats and the cabin interior may be arranged in any way preferred. Below, dressing the coamings so they have graceful curves



Scene at the NYA Youth Center, Hazelton, Pa., where students use these lockers for a variety of hobbies

Combination Hobby Locker, Seat, and Workbench



Three types of cabinets and method of construction. One lock serves for all the compartments

THE combination hobby lockers, workbenches, and seats illustrated are in the Hazelton Youth Center, Hazelton, Pa., sponsored by the National Youth Administration for Pennsylvania. They were designed by J. L. Zerbe, director of the Youth Center, and constructed by NYA youth under the supervision of Harold Faust, WPA shop foreman in the center. The six lockers line half of the general activities room where space is at a premium.

The six lockers provide storage room, working space, and display shelves for the finished products for the following activities: drawing, needlework, handicrafts, constructive hobbies, bookbinding, and art. One locker of each type is in each tier. The two end ones, for drawing and art, have an extra compartment for the storage of large drawing paper and boards.

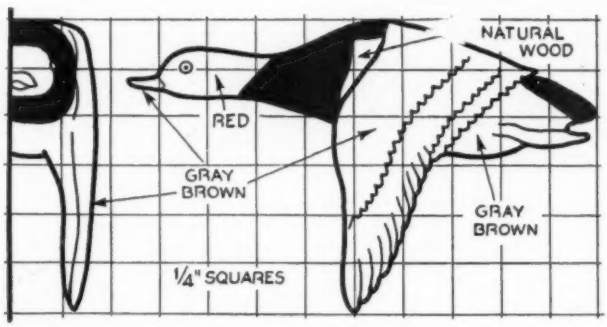
The drawings show each type of locker open. Sufficient information is given in the detail drawings for anyone to build similar lockers for his basement, shop, or den. Each locker in the Hazelton Youth Center is 5′ wide, which necessitated the middle reënforcement shown in the photograph. The workbenches for drawing and art have two thicknesses of ¼" plywood to strengthen as well as to bring the working surface flush with the inclosing

frames. To reënforce and steady these large boards still further—they have a 30" by 60" drawing surface—lightweight chains are attached from the corners to the inside of the top. When the boards are swung shut, the chains hang inside. The frames around the other boards extend ¼" above the working surface and serve to prevent tools and small equipment from being pushed off.

One lock under the seat serves to lock all compartments of a cabinet. In order to open the compartments above the seat, the seat is raised; this allows the sliding bar to drop below the upper edge of the pivoted door, which, when pushed in at the bottom, drops into a horizontal position. It is held from dropping below the horizontal by blocks at either side, which serve also as supports for the shelf.

The middle lockers have a compartment at the top. The bottom of the upper door, which swings up, is beveled to fit the bevel at the top of the pivoted board. It cannot, therefore, be opened until the pivoted door is opened. The locker at the left has the compartment below the pivoted door. It is held fast when the seat is down by a right-angle hook, which engages a screw eye. When the seat is raised, the angle piece drops down with the sliding bar on which it is fastened. Thus all doors are released when the seat is raised.

Full-size front and side views of the duck are given at right. Below is the completed bird mounted on a basswood box with a suitable grain



Small Gift Box DECORATED WITH Redhead Duck

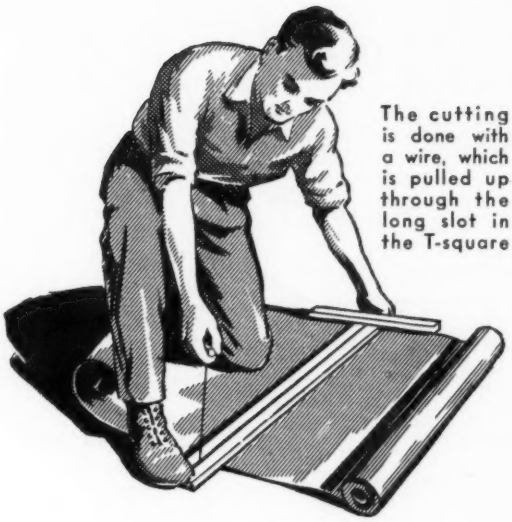
BIRD lovers will appreciate the gift of a small box decorated like the one illustrated with a redhead duck carved from wood. Suitable basswood boxes may be purchased from a craftsman's supply house in various sizes. This particular one is 1½" by 3¾" by 5⅝". Choose a box, if possible, where the grain gives the appearance of the edge of a pond. Stain the wood light oak.

Glue together three plies of ⅛" thick gum or whitewood and draw the duck on this. Cut it out, and shape it with rotary files or by hand. Undercut the wing. If the smallest artificial eye sold by taxidermists can be obtained, it gives the best effect for the eye. Drill a hole for it and a still smaller hole for the wire. Cut the wire short and glue the eye in place.

Stain the head a red mahogany color, and the bill and body gray. Nitric acid in which silver has been dissolved until there is no bubbling makes an excellent stain. Color the neck and tail with black waterproof ink, and leave a narrow triangle above the upper edge of the wing in the natural wood color. Fasten the bird to the box by means of glue and two small screws inserted through the cover from the inside.—EDWARD B. FOX.

Rubber Band Keeps Bottles of Drawing Ink Together

WHEN three different colors of ink are used in drafting, it is convenient to fasten three standard bottles together with a strong rubber band. Held in this way, they will not tip over and require less space than separate bottles.



The cutting is done with a wire, which is pulled up through the long slot in the T-square

Roofing Paper Cut Neatly with Special T-Square

ROOFING or tar paper can be cut squarely and neatly with a T-square of the type illustrated. It has a slot down the middle through which a wire runs. The wire is simply pulled up to cut the paper.—N.W.

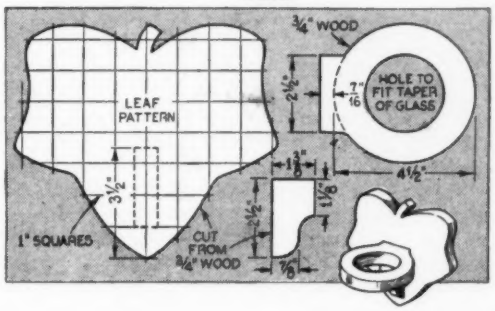
Filling Cracks and Nail Holes

A TOUGH, tenacious wood filler for cracks and nail holes consists of two parts by measure of fine sawdust, two parts whiting, two parts asbestos cement, and one part casein glue. Mix with water to a thick paste.

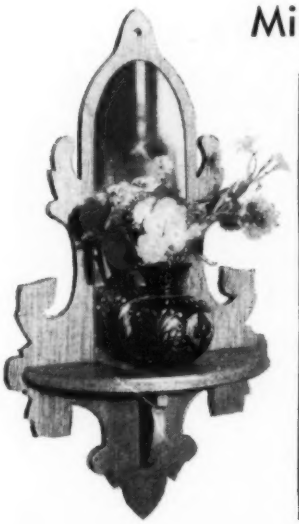
Leaf-Shaped Wall Bracket Holds Ivy in Tumbler

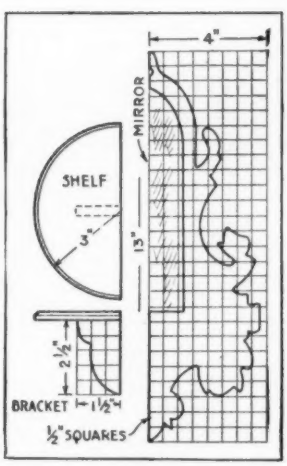
SHAPED like an ivy leaf and painted green, the bracket below is designed to hold an ivy plant in a common glass tumbler. Cut the three pieces from ¾" thick wood as shown and make the hole to suit the slightly tapered tumbler. Assemble with two flathead screws through the leaf into the glass holder, and two screws into the brace, one through the leaf and the other through the back part of the ring. Apply several coats of grass-green paint or enamel.

A screw eye or a brass eye plate may be used as a hanger. If a plate is used, sink it flush with the back of the leaf, and drill a blind hole into the wood through the metal eye to receive the head of a nail.—G.A.S.



Mirror Ornaments Small Hanging Shelf





IN CONSTRUCTING the project illustrated at the left, any amateur craftsman will be rewarded far beyond the small amount of material required. It is a miniature shelf mirror, so small that it may be used almost anywhere on a wall with pleasing effect. The original, which is used to hold a vase with diminutive wild flowers, is made of mahogany in the so-called "blond" finish, but other hardwoods and finishes are quite as satisfactory.

Scroll-saw the backpiece, bracket, and shelf to shape and assemble with small screws, countersunk and plugged. The mirror can be cut at a glazier's or by an automobile-body repairman. Fasten the mirror directly to the wood with model-airplane cement.—L.R.B.

Etching Press

BUILT FROM AN OLD CLOTHES WRINGER

By Arthur Paul Snader

An easy way to set up an old clothes wringer for printing dry points

HOW TO MAKE DRY POINTS

PART TWO

TRIAL proofs of a dry point can be made by using a common rolling pin with a slightly dampened blotter as a "press blanket." However, with a little ingenuity and at practically no expense, you can convert an ordinary clothes wringer into a serviceable press.

If an old one, in which the rubber rollers have hardened, is available, so much the better. The junk shops and sometimes second-hand furniture stores are a good source of supply. The old wooden wringers usually require little alteration, because they have two pressure screws at either side of the top of the frame. Various methods of transmitting this pressure to the rollers are employed, but generally speaking these may be removed entirely and the following method substituted:

Cut about one dozen or more squares of cardboard (heavy pulp board is excellent) to fit between the uprights at either side of the frame on top of which are the pressure screws. Place this packing—about six at either end—between the bearings of the upper roller and the pressure screw above. A small metal plate tops off the cardboard pack as a footing for the screw.

To hold the wringer solidly erect, a base may be provided. One way to do this is to cut two boards about 1″ by 4″ by 30″ and screw them firmly to the sides of the uprights at the base. Close the ends of these supports with cross boards cut to the proper length, and reënforce with angle irons.

Should the wringer possess screws at the foot to attach it to the side of the tub, a box base could be built. Another method is to attach the wringer to a table with angle irons.

Now fasten a strip of wood, a length of angle iron, or a piece of very heavy wire to both sides of the wringer parallel with the rollers at a height just even with the top of the lower roller. This serves as a rest for the traveling bed to prevent it from moving up and down as it passes through the rollers.

Obtain a piece of pressed-wood composition board ½″ narrower than the length of the rollers and about 20″ long. This is the bed, which is inserted between the rollers. Two or three sheets of blotting paper, the face sheet slightly but evenly moistened, make adequate blankets. Tighten the screws on the top of the wringer to give as much pressure as possible without causing the upper roller to bow up in the center.

To prepare the plate for printing, first rub

Rubbing the back of a plate with yellow laundry soap

the edges with 2/0 sandpaper so there is a slight bevel sloping from the face to the back of the plate. Now lay the plate *face down* upon a number of sheets of old newspaper and rub a smooth coating of yellow naptha laundry soap upon the back. Be careful to carry the coating to the extreme edges, pushing the soap from the center outward. Avoid lumps.

Lay the soap-coated back of the plate upon a piece of heavy cardboard, cover the face of the plate with a fresh piece of newspaper, and run the assembly through the press (or roll heavily with a rolling pin). This fastens the plate to the cardboard. Trim the edges with a razor blade or frisket knife and smooth with sandpaper.

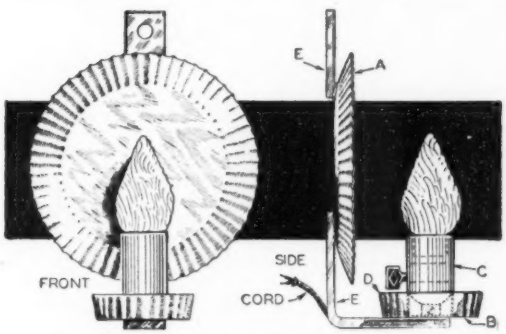
An alternate method is to use artists' rubber cement in place of soap. In this case, both the back of the plastic and the face of the cardboard are thinly coated with cement and allowed to dry; then pressed together between the rollers. Examine the edges for surplus cement and rub it away, lest it get upon the wiping rags and impair your prints.

It is very important that all the edges of the plastic plate adhere firmly to the cardboard, and for that reason they are often run through the press a second time before being trimmed.

(TO BE CONCLUDED)

Small reproduction of a print made from a plastic plate

Antique Bracket Lamp Constructed from Sheet Copper



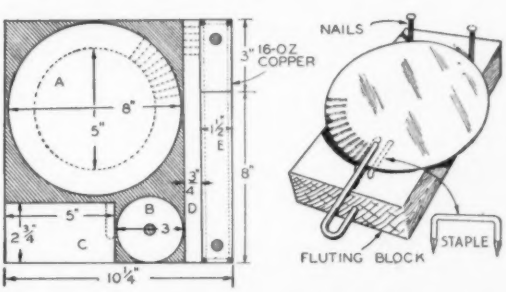
Front and side views of the electric wall fixture

ALL five metal parts of this seventeenth century bracket lamp are cut from a single piece of 16-oz. copper, 10¼" by 11". Disk *A* is the reflector; *B*, the bottom for the candle tray. The piece marked *C* is rolled into a tube to cover the socket after a notch has been cut in one corner to slip over the switch key.

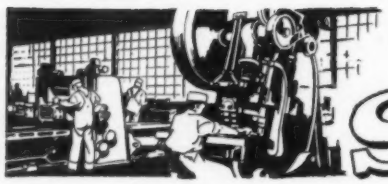
Strip *D* is fluted and soldered to the rim of *B* to complete the candle tray; then *C* is soldered in the center. Strip *E* is divided into two parts, 3" and 8" long respectively, and the edges are bent up on three sides of each as indicated by the dotted lines. These bent-up edges are ¼" wide. One ⅜" hole is drilled in each piece as shown. The longer strip is bent at right angles in the center to serve as a support for the candle tray. The 3" piece is for hanging the lamp. Both parts are soldered to the back of the reflector.

The fluting is done before assembly on a hardwood block 6" by 12", made as illustrated. To insure even work, mark the rim of the reflector with light scratches ⅜" apart before attempting to do the fluting. Place the guide nails so the fluted rim will be 1½" wide. Flute the rim for the candle tray in the same way, although in this case no guide is needed; merely mark the flutes.

The lamp may be finished by polishing the copper and applying a coat of metal lacquer.—HAROLD JACKSON.



Layouts for the parts and sketch of fluting block



NEW SHOP IDEAS

Diamond Holder

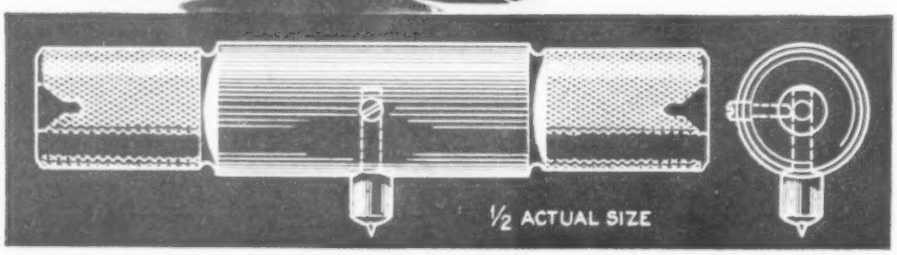
FOR DRESSING TOOL-POST GRINDER

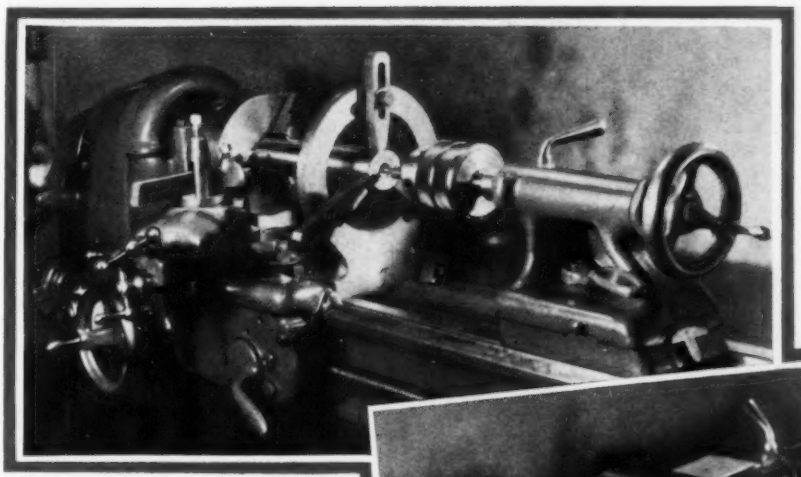
IF YOU have a tool-post grinder, you will need a diamond dresser to true the wheel. A good diamond in a mount an inch or so long can be had for about three dollars, but this will have to be fastened rigidly in the lathe. To do this, a holder may be made as shown.

A piece of cold-rolled steel 1⅜" in diameter by 7" long is mounted in a three-jaw chuck and steady rest, and large, deep center holes offering a good grip on the lathe centers are drilled. In this instance a J-1 bell-type combined drill and countersink was used, having a body diameter of ½" and a drill diameter of 7/32". Protected centers are

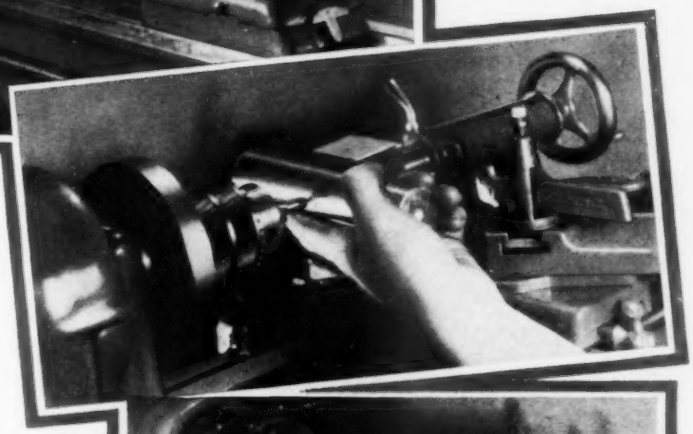
The diamond dresser clamped tightly between lathe centers ready for truing up the wheel of a tool-post grinder. The tailstock must be drawn up very tight

Left, the finished holder with lathe dog. The diamond mount is held in place with a set screw. All details may be seen in the drawing below

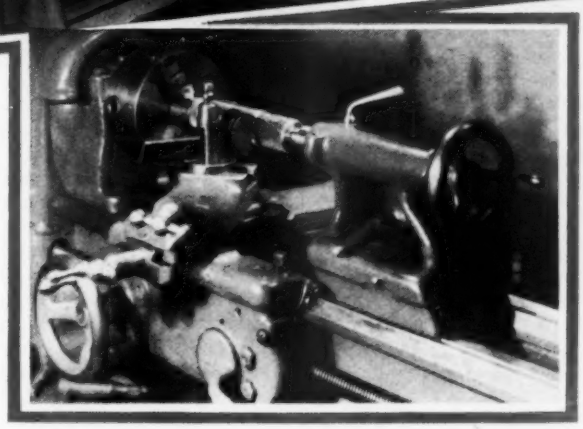




The bar is mounted in a chuck and supported with a center rest so that the deep center holes may be drilled



Below, drilling hole for the diamond mount. The stock is held with the aid of a crotch center. A large center drill is used in order to start the hole true



For convenience, the ends of the holder are knurled. Both the knurls and the dead center are heavily flooded with oil

obtained with this kind of center drill, and they are best for this particular job.

The hole for the diamond mount is next drilled in the side of the bar, and one for the set screw to hold it in place. This is done in the lathe with the bar held in the crotch center. The ends of the bar are next turned down to the dimensions shown in the drawing and knurled for convenience in handling.

Knurling is best done at a slow speed with plenty of oil flowing over the work, the tool, and the lathe center. Considerable pressure is needed to sink the knurls into the work. Drive the work by a chuck and as it lengthens by expansion from the heat, it will be forced farther into the jaws of the chuck instead of burning the dead center of the lathe.

After being knurled, the ends are chamfered, and the bar is polished with fine emery cloth. The set-screw hole is tapped, and the diamond slipped in place.

In use, the bar must be clamped tightly between centers. Any play or chatter here will be fatal to the diamond, which is brittle and will chip or crack very easily if it is struck a sharp blow. A guard should cover the wheel, and a stream of water be used to cool the diamond. It is well, after each dressing, to give the diamond a quarter turn in the holder so it will present a new cutting edge to the wheel, as a worn or rounded diamond will smooth the surface of the wheel, which will then heat the work while in use and cause no end of trouble. On the other hand, a properly cared-for diamond will put a keen cutting surface on the wheel and make your grinding much more of a pleasure.—C. WARREN WOODSON.

Pliers Padded with Leather

WHEN soft or highly finished metals had to be gripped with pliers, I used to wrap rags around the work as a protection. Now I cut the fingers off discarded leather gloves and slip these stalls over the jaws of the pliers. They prevent slipping and scratching, yet are not in the way.—FRANK REYNOLDS.

Aluminum Castings Welded by the Puddling Method

The aluminum casting before and after being repaired. Below, working in metal with the puddling rod

EVERY one who uses the oxyacetylene welding torch should have some knowledge of how to weld aluminum for the odd jobs that occasionally arise. It doesn't pay, however, to waste time and gas on repairing kitchen aluminum ware.

A typical job is illustrated. The square lug on an aluminum casting from a washing machine had been broken out in one place and cracked in several others. It was decided to build up a new lug, so the old one was sawed off slightly below the lowest crack. The casting was then cleaned bright on the side to be welded. A supply of cast aluminum rods was placed near at hand, and a No. 2 tip selected.

Two methods of welding aluminum are used—with the aid of a flux and by using a puddling rod. The latter is a rod 3/16″ in diameter and about 12″ long. One end has a loop for ease in handling, and the other is flattened to about 1/16″ thick.

The difficulty with using flux is that any flux active enough to destroy the oxide coat will continue to eat the aluminum long after the job is finished, unless it is completely removed or neutralized. The flux also makes the metal very fluid and hard to control.

With the puddling method, the oxide coat itself is utilized. This coat melts at a temperature very much higher than the metal, so it may be used as an envelope to help hold the metal in shape. A small quantity of the filler rod is melted and rests on top of the metal to be welded; then it is worked into the parent metal with the puddling rod. The oxide will come to the surface, and a clean, strong weld will be made. This is repeated until the desired size is reached. The built-up portion may be worked to shape and smoothed with the rod.

Aluminum in the proper state for puddling resembles soft ice cream. When it is hot enough to puddle, merely dragging the rod over it will leave a small, bright groove. Just before it turns liquid, small bright spots will appear on the surface. Then you must watch closely because in a few seconds the casting may turn into a pool of liquid metal.

Since aluminum has little strength when near the melting point and as it expands and contracts considerably, it must be free to move during the welding. Never try to clamp it in place.—W. C. CHENEY.

Metal Layouts Marked on White Coating

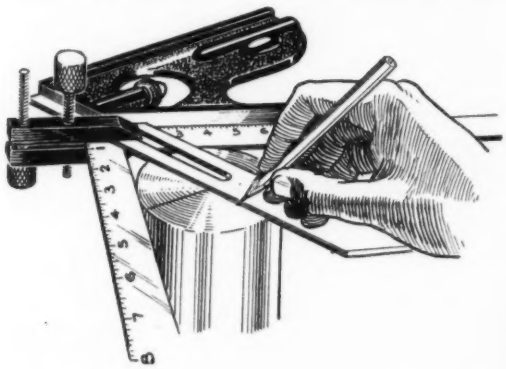
AN OPAQUE white surface for laying out work accurately and clearly on metal may be obtained by applying ordinary white shoe cleaner. Shake the bottle well and warm the work slightly, if possible, so the cleaner can be applied faster. The coating is so smooth that even fine pencil lines can be drawn on it and readily seen—a great advantage for work such as illustrated. The cleaner is easily wiped off after the work has been completed.—S. J. GANCHER.

Never hold a cloth this way for polishing a shaft

How to Hold Emery Cloth When Polishing Shaft

CARE should be taken, when polishing a shaft in a lathe with emery cloth, to hold the cloth in a safe way. If the cloth is wrapped all the way around and both ends held pinched together as above, the cloth may become caught and wrap itself around the shaft. The thumb is apt to be pulled in and pinched or badly injured. A much safer method is to hold one end of the cloth in one hand, pass the other end over the shaft but not all the way around it, and grasp it on top with the other hand.—J.C.

You won't get your fingers injured with this grip

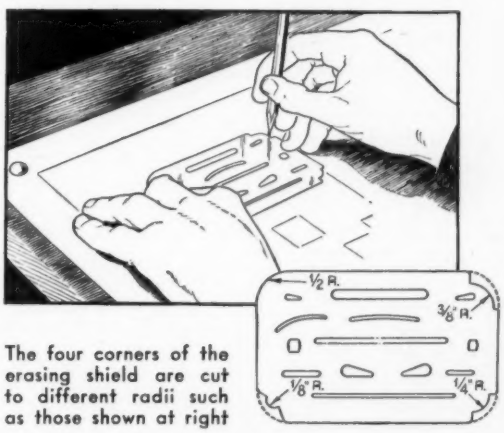


A Substitute Center Head for Combination Square

WHEN a combination square has no center head, a substitute may be improvised with the aid of a steel square, as illustrated. The miter face of the combination square is so placed that the blade bisects the angle formed by the junction of the inner edges of the steel square. If the steel square is held in this position by means of a small clamp, the tool may be used to find the center of any piece of round stock.—S.J.G.

Templates Increase Utility of Draftsman's Shield

THE utility of a draftsman's erasing shield may be greatly increased by cutting the corners as shown to the radii most frequently used. The shield will then serve as a template for drawing these standard fillets and rounds.—E. E. MCNUTT, JR.



The four corners of the erasing shield are cut to different radii such as those shown at right

The glasses slide out to give access to the small compartments. Below, making a section

Small Fittings Stored Visibly

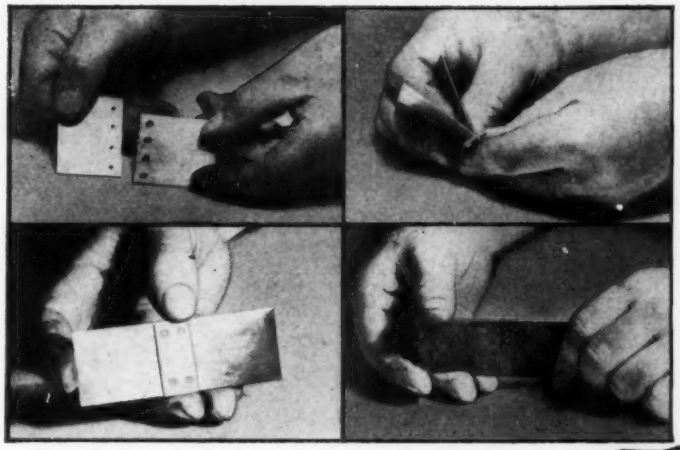
IN GLASS CABINET

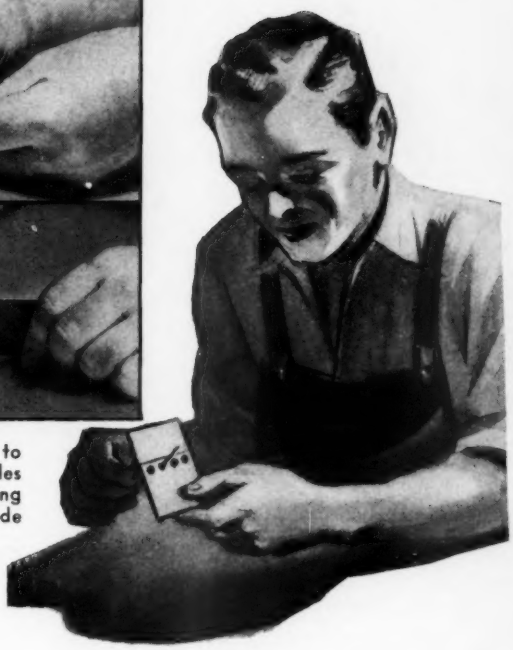
IF ALL the odd wheels, gears, shafts, brackets, and other small fittings that accumulate in your shop are stored in glass "show cases" as illustrated, they can be located quickly when you want them.

The various sections of the cabinet are made as shown. The glasses, which fit into saw cuts in the wood strips, can be cut from scrap strips of glass 4″ or 5″ wide, which can be had for little or nothing.

A case is made to hold the various containers. The outer one is hinged to the case at the bottom with ordinary three-section hinges, but these are altered by cutting off one of the end sections and soldering the pin to the opposite end so that the whole container can be removed from the cabinet by sliding it sideways when it is dropped down.

The inside containers are held in place by headless nails, which project from each side next to the bottom corner. These nails fit in slots cut in the sides of the cabinet at an angle of 45 deg. When the sections are tilted out and lifted slightly, the nails slide up through the slots to the front of the cabinet, and allow the sections to drop down. To keep the nails from sliding out of the slots, a nail is driven across the end of each slot on one side of the cabinet. The slots on the other side are left open so the sections can be taken from the cabinet.—MERLE TERRILL.





After holes are drilled as shown, a punch is used to press the metal of one piece through the larger holes in the second piece, as at the right. By fastening both pieces to a third piece, a butt joint may be made

Fastening Thin Sheet Metal Without Using Rivets

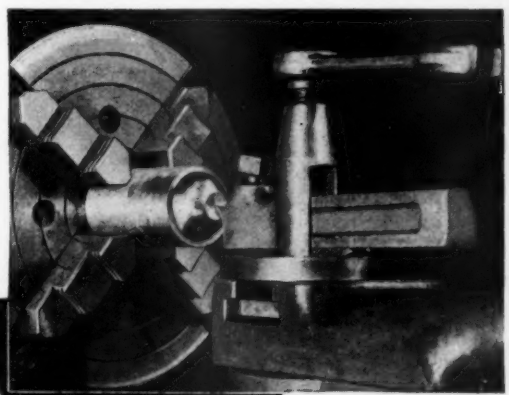
TO FASTEN very thin sheets of metal together without rivets, drill a row of small holes through both sheets and enlarge the holes in one sheet to about three times their original diameter. Place the two sheets together and press the metal around the small holes in the one sheet through the larger holes in the second sheet with a taper punch as illustrated.

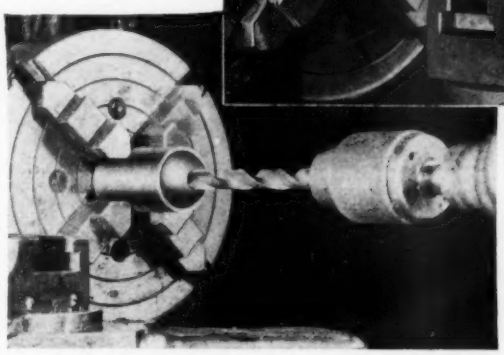
If the holes are objectionable, the two sheets can be bent at right angles and fastened to a third sheet, then flattened again as shown to conceal the holes and also form a butt joint.—M.T.

Drilling Through Center of a Steel Ball

WHEN it is necessary to drill a hole accurately through the center of a ball, the following method will be found satisfactory: A short piece of pipe having a hole slightly smaller than the diameter of the ball is chucked in the lathe and bored out on a slight taper (about 2 or 3 deg.) just large enough to admit the ball. The ball is pushed in tightly with the back of the tool holder, or tapped in carefully. With the turning tool, cut a starting hole for the drill, and then drill, first with a small drill and finally to size.

Balls from old ball bearings may be annealed, drilled in this way, and put to many uses.—JOHN COOK, JR.





Cutting the starting hole and, left, drilling the ball. If annealed and drilled in this way, then tapped, balls from old ball bearings may be used for many purposes

Wrought-Iron

A HOBBY THAT COSTS LITTLE FOR

IRON or mild steel is an economical and satisfactory material for decorative metal work of the type shown in the accompanying photographs. It can be purchased at hardware stores or supply house in strap, square, and round forms and in a great variety of sizes. The addition of a bending fork and lever, and a set of jigs to the ordinary equipment of a workshop will enable the home worker to produce work rivaling that of master craftsmen.

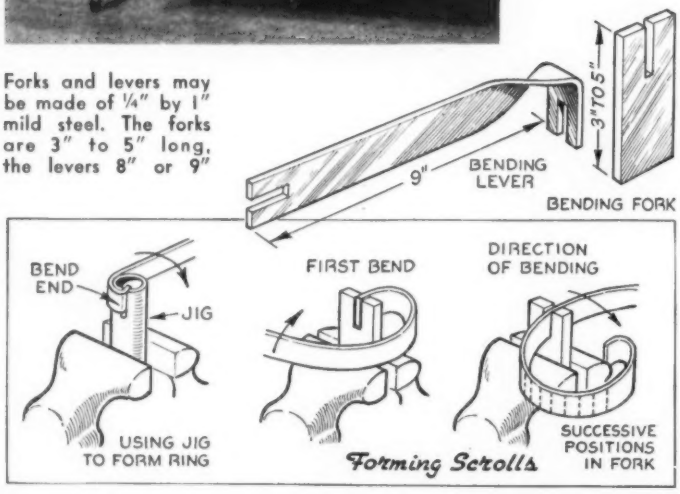
Forks and levers may be made of ¼" by 1" mild steel. The forks are 3" to 5" long, the levers 8" or 9"

Slots of different widths are cut into the ends of the forks and levers to suit the size stock used. The jigs for forming loops are short pieces of pipe slotted at the end to receive the stock.

To make small loops or rings, a jig of suitable size is clamped upright in the vise. Bend the end of the strap at a right angle and place it in the slot of the jig; then wrap it around snugly, hammering lightly if necessary. If the small right-angle bend projecting into the circle is objectionable, it may be cut off with a hack saw after forming.

For a curve or scroll, sketch a full-size pattern on a piece of board or paper. Place the strap iron between the prongs of the fork, bend slightly, slip forward a short distance, and bend further. By testing on the pattern, the progressive bend can be made. For short bends or where more power is necessary, the bending lever may be used. The jaws of a monkey wrench make a satisfactory substitute for a bending fork or lever. In forming twists, if a piece of pipe is slipped over the strap, any tendency to kink will be overcome.

Several methods of making end joints are suggested. If a method of heating is available, a satisfactory joint may be made by brazing.

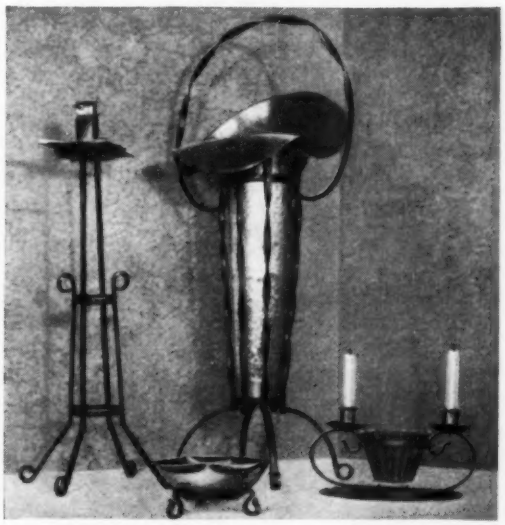


It is usually desirable to hammer the surface of the metal. Remember, however, that the hammering of antique wrought-iron work was intended to smooth rather than to spot for decoration. A hammer having a broad, slightly domed striking surface therefore generally gives a more natural appearing surface than a ball-peen or cross-peen hammer.

The ivy-jar holder shown, which will serve as an example, was developed to fit a quart-size prune-juice bottle, and 1/16" by ⅜" strap iron was used.

Work...

TOOLS AND MATERIALS



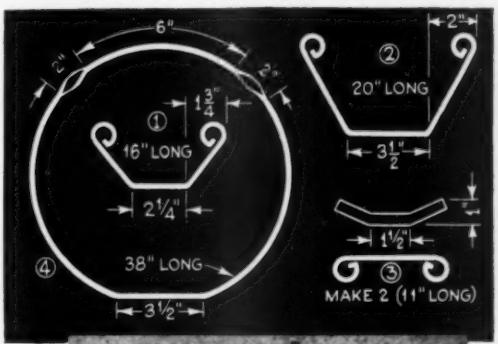
Starting to form a scroll. Strap iron up to 3/16" by 1" may be worked cold with ease

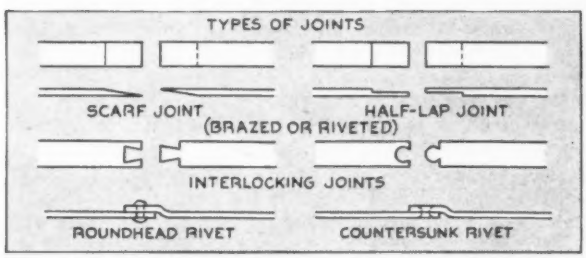
By W. S. KREHBIEL

Metal-Craft Instructor

L. G. Hine Junior High School
Washington, D. C.

After all pieces have been cut to proper length and hammered, locate the center of each. Measure from the center line for the angle bends of pieces 1, 2, and 3, and for the twist in piece 4. Bend ¼" of the ends of 1, 2, and 3 at a right angle, and form 1" loops around a jig. Clamp in the vise at the angle line and bend the angle, testing with try square and rule to get the proper angle. To form the twist in piece 4, clamp in the vise at the 6" mark, place a monkey wrench or bending lever at the 2" mark, and twist for a half turn. Make the end joint and form into circle. In pieces 1 and 3, drill a ⅛" hole at the center line. In pieces 2 and 4, drill a ⅛" hole at the center line and 1¼" on either side. Assemble with ⅛" iron rivets.



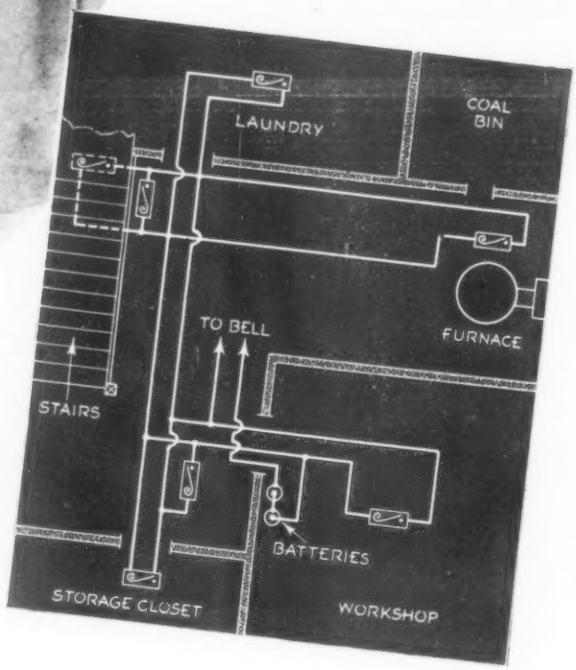


Ivy-jar holder and, above, the drawings. Articles of this type may be lacquered or painted any color; or, for a black finish, heated to a uniform color, then quenched in oil or rubbed with paste wax

Foolproof

Many types of homemade fire alarms have been devised, but this one was designed by a member of a city fire department who knows from long experience the essentials of a foolproof system. He installed this type of fire alarm in his own home more than a year ago, and it has already proved its worth by giving warning to prevent what might have been a serious fire.

Thermostats are fastened to the ceiling at the points where a fire is likely to start, especially in the cellar and under all stairs



IF PROPERLY constructed, this inexpensive alarm system will give unfailing warning in case of fire in your home. You will need one or more discarded automobile thermostats of the kind that fit inside the radiator hose. Probably your local garage has a few lying around and will be glad to get rid of them. Other materials required are an old hard-rubber or composition radio panel, some 8-32 flathead screws, a piece of ¼″ brass rod, a small piece of heavy sheet brass, a few small lock washers, some soldering lugs, the necessary wire, a doorbell, and two dry cells.

Take each thermostat apart, being careful not to damage the bimetal spring. Straighten the spring to lie perfectly flat, clean it, mark it into ¼″ wide strips, and cut it with shears as in Fig. 1. This will give five pieces ¼″ by 5″. Discard any that are worn or corroded.

Prepare one piece of the panel material like Fig. 2 for each thermostat you intend to install. Cut the brass rod into as many ½″ lengths, drill one end of each, and tap for a 8-32 screw. Slot the other end ¼″ deep as in Fig. 3. Then cut the sheet brass into ⅜″ by 1″ pieces and bend, drill, and tap as in Fig. 4.

Force one end of a piece of the bimetal element into the slot in each brass post and solder in place. Hold the other end of the rod in a vise and wind the bimetal carefully around, about a turn and a quarter, with the *steel* side of the bimetal out and the *copper* side in. Wind this loosely so that the coil will be about ¾″ in diameter as in Fig. 5.

Home Fire Alarm

USES OLD AUTO THERMOSTATS

By Louis F. Lehner

Thermostat ready to be installed. A cover, left, is needed only when the device is located where it might get damaged

This should leave the other end extending about 2⅛" from the center of the rod. Make a sharp point at this end. Now fasten this unit and one of the brass angles to the base as in Fig. 6. Use both a lock washer and a soldering lug under each. Next bend the pointed end of the bimetal as shown so that when it swings toward the brass angle it will touch in the center. Set the point ⅛" away and fasten the screws as tightly as possible.

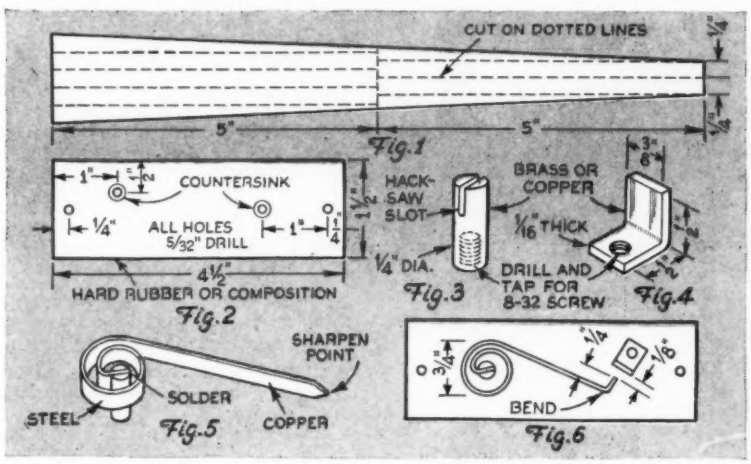
The plan on the opposite page suggests where the thermostats may be placed. As most fires originate in the cellar, cover that thoroughly. Be sure to install one under the cellar stairs and under the stairs leading to the upper floors. Put one behind the heater in the cellar and another behind the kitchen range. Closets may be included in the hook-up. Remember that heat rises, so the thermostats should be on the ceiling if possible.

Where there is no danger that anything will come in contact with the thermostats, they may be left open; otherwise a cover should be made of any sheet metal as illustrated above. Nickel-plated or polished brass covers may be used if thermostats are installed in any of the living rooms.

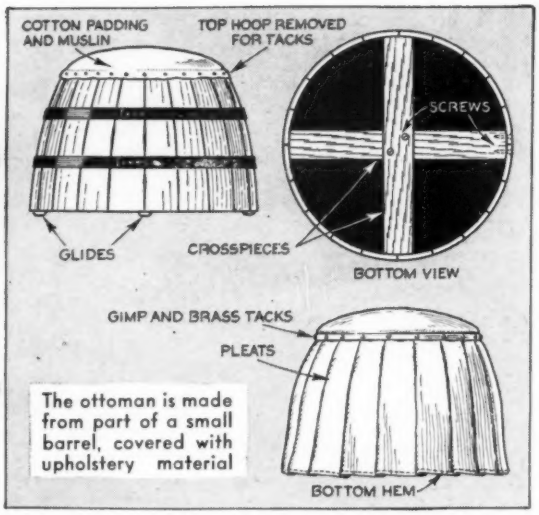
Place the bell inside, where it can be heard night or day. If you are willing to spend a little more, get a 6" gong and a couple of extra batteries. Place this gong outside in some sheltered position and explain its purpose to the neighbors.

A transformer could be used instead of batteries, but this is inadvisable since many fires start from defective wiring and also from lightning, in which case the fuse usually blows just after the fire has kindled and before the thermostats can operate. Modern standard dry cells are reliable and should last about two years.

Use high-grade insulated wire and solder and tape all connections. Some of the thermostats, such as one behind a heater, may have to be adjusted to a slightly wider opening. Clean the contact points once a year and test them, preferably once a week, by putting a piece of metal across the contacts. Remember also that you can install one or more thermostats in the garage or other out-buildings.



How strips for five thermostats may be cut from a single flattened bimetal spring; the base and other parts, and the method of mounting and assembling



INEXPENSIVE Ottoman

MATCHES BARREL CHAIR

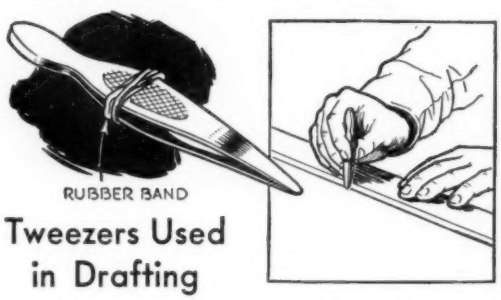
THOSE readers who have constructed a barrel chair as described in a previous article (see P.S.M., Oct. '38, p. 180, and Nov. '38, p. 190) will find that an ottoman similarly made is an excellent companion piece.

Obtain a small barrel, approximately 24″ high and 14″ across the head; saw it in two, and brace the cut section as shown. Attach glides at the ends of the crosspieces. Remove the top hoop to allow room for tacking. You can nail each stave into the head for extra security, although this is not essential.

Pad the top well with kapok or cotton, stretch muslin over the padding, and tack along each stave ½″ from the top. Then cover with your upholstering material. Sew a 1″ hem in the flounce and pleat it every 2″ or 3″, depending upon how wide you made the pleats in the chair. Fasten the gimp with upholstery tacks.—GEORGE E. BASICH.

Bathroom Stool Doubles as Shoe-Shining Stand

BY ADDING a small drawer to a metal bathroom stool of the type illustrated, it can be made to serve double duty as a shoe-polishing stand. The drawer slides on two strips of wood screwed to crosspieces that are, in turn, fastened to the legs of the stool. A circular piece cut from a discarded bath mat is kept in the drawer and used to protect the stool. —BERTRAM BROWNOLD.



Tweezers Used in Drafting

IN AN emergency an old pair of tweezers may be used as a substitute for a drafting pen. Wrap a small rubber band lightly around the tweezers about halfway up as shown above and, if necessary, grind the ends to obtain a thinner and smoother line. This tool will also serve as a striping pen for model work. It may be readily adjusted for wider lines by placing a small wooden wedge between the bades.—ROBERT RUSSELL, JR.

Making Colorful Mexican Sport Belts

IS NEWEST FAD

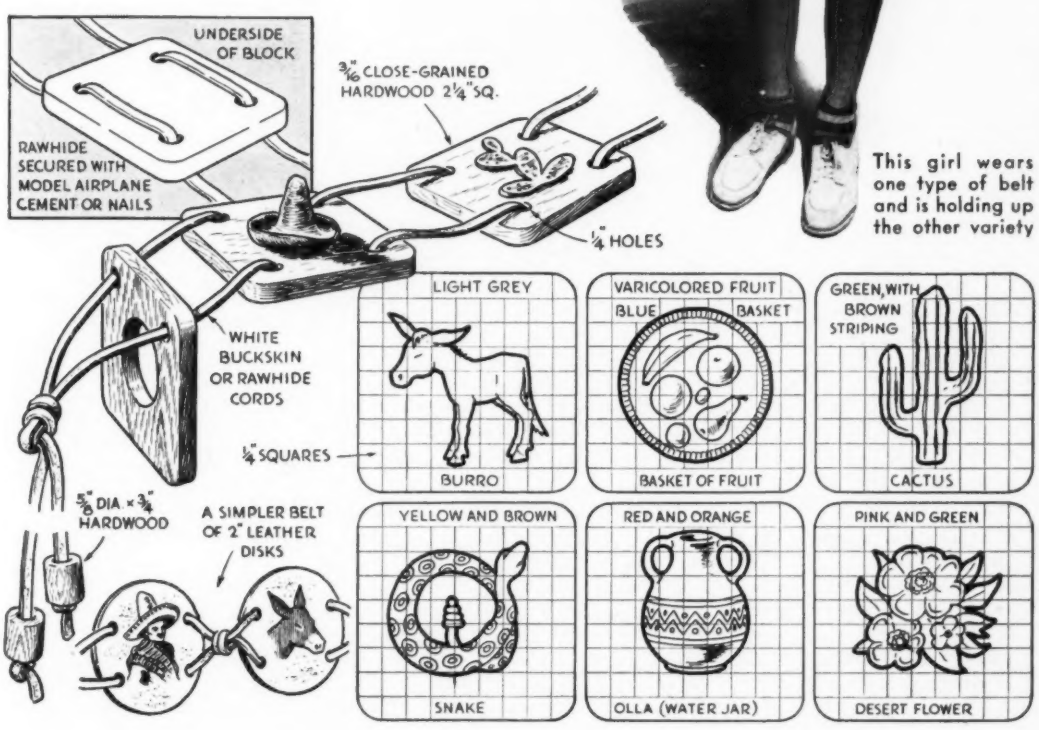
IT'S a lot of fun to start a new fad in your community, and this "Guadalajara girdle" has no end of possibilities, especially for school girls. The decorations may be Mexican designs, animals, flowers, or even burlesque figures of friends.

Prepare nine pieces of thin wood such as gum, maple, birch, or sycamore, 2¼" square or smaller, and bore holes in each corner. A local shoe repair store can either provide the thongs or get them for you, and self-hardening plastic clay is obtained at art stores.

Draw each figure on paper, thumb tack waxed paper over this, and mold the clay to the outlines. When hard, paint the clay as desired, but not the underside. Handle the figures carefully, because they are quite fragile at this stage. Next cement them to the blocks with model-airplane cement. The whole should then be varnished or shellacked with at least two coats.

Another method is to make the belt from leather disks, with the figures painted on or burned with a pyrographic pen. This type is strung together with leather thongs as shown.—DOROTHY BROWNE.

This girl wears one type of belt and is holding up the other variety



FUN

Glass marbles float in Thoulet's solution, which you can prepare by dissolving some red mercuric oxide in potassium iodide

MERCURY seems to be nature's joke on the scientist. The only metal that is liquid at ordinary temperatures, it still outweighs most solid ones—lead included. Volume for volume, among all the substances you encounter in your everyday life, only a few such as platinum, gold, and tungsten are heavier than mercury. Though it runs like water, it does not wet objects, and a drop of mercury in the palm of your hand is so elusive that it defies you to pick it up with your fingers.

You might expect that you could perform strange experiments with the compounds of such a queer metal, and you will not be disappointed. Through a magnifying glass or a low-power microscope, you can watch yellow crystals change magically to red when you touch them with a needle. You can make a transparent liquid so heavy that glass marbles will float in it. Trick boxes of matches, easily prepared in your home laboratory, will produce April-fool "serpents" when lighted.

By RAYMOND B. WAILES

Suppose you start with the color-changing experiment. Dissolve about twenty grams of potassium iodide in 200 cubic centimeters of water (or four teaspoonfuls of the chemical in seven fluid ounces of water). Also dissolve ten grams of mercuric chloride, more familiarly known as bichloride of mercury, in about 300 cubic centimeters of water. (This is equal to one teaspoonful of the chemical in ten fluid ounces of water; note that the abnormal weight of mercury compounds makes it necessary, for once, to deviate from the rough-and-ready rule that a teaspoon holds about five grams of a dry, powdered chemical.) REMEMBER that mercuric chloride is a deadly poison, but may be handled safely with ordinary precautions, such as keeping it away from the mouth, and washing the hands thoroughly after using it. Both the potassium iodide and mercuric chloride solutions will be water-white.

Slowly pour some of the potassium iodide solution into the mercuric chloride solution. A brilliant red precipitate forms. It consists of mercuric iodide. Let it settle, and add more potassium iodide to the clear part of the solution. If more precipitate forms, let it settle, and repeat. Stop adding potassium iodide just at the point where no more precipitate is produced. Then filter off the red mercuric iodide. Wash it well as it lies on the filter paper in the funnel, and then let it dry in the air.

This red powder will turn yellow if you heat it above 126 degrees centigrade (259 degrees Fahrenheit). Mix it with weak mucilage, or varnish, and you can use it

with QUICKSILVER

Mercury, the Liquid Mystery Metal, Offers a Fascinating Field of Experiment to Amateur-Chemistry Enthusiasts

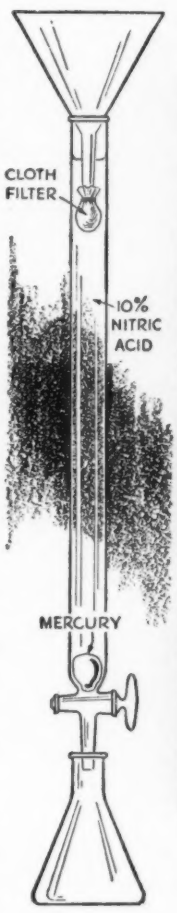
as a heat-indicating paint. The yellow color will change back to red after some hours. Scratching the preparation hastens this change.

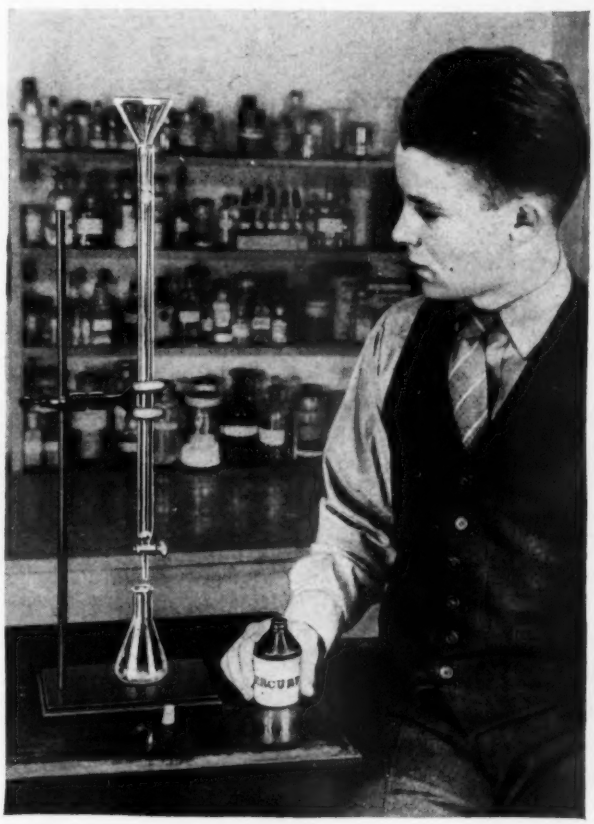
The color change from yellow back to red will also occur more quickly if the original precipitate of red mercuric iodide is converted into crystals. To do this, shake a gram or so of the powder with about ten cubic centimeters (three teaspoonfuls) of acetone for about ten minutes. Filter the solution, collecting the liquid that passes through the filter in a watch glass. The solvent rapidly evaporates from the watch glass, leaving long, gleaming crystals of mercuric iodide in a few minutes' time.

Place several of these red crystals on a microscope slide or a sheet of metal. Warm them gently, over a small flame, until they turn yellow. Now observe one of the crystals under a microscope or magnifying glass, while you apply pressure to it with the point of a needle. Wherever the pressure stresses it, the crystal instantly turns back to red. Warm the crystal again, and the striking experiment can be repeated as many times as you wish.

If the solutions of potassium iodide and mercuric chloride are hot when you originally mix them, the mercuric iodide that precipitates will be yellow instead of red. In this case, the precipitate settles slowly. Half an hour after mixing the solutions, the bottom of the beaker will be covered with red mercuric iodide, and yellow mercuric iodide will still be dispersed through the upper part of the solution, slowly settling out and changing into the red form.

Now for the trick of floating glass marbles in a liquid. Can you imagine a solution heavy enough to buoy up glass, bricks, and many kinds of rock, like corks in water? This remarkable fluid—which is known as Thoulet's solution, after the French chemist who introduced it—is easy to make for your self. It is prepared simply by dissolving





PURIFIER FOR MERCURY. Baser metals amalgamated with mercury can be removed with this simple apparatus. The quicksilver passes through nitric acid, which dissolves impurities

"Pharaoh's Serpents" Writhe from Trick Matches
ADD SODIUM SULPHOCYANIDE TO MERCURIC CHLORIDE
UNTIL PRECIPITATION STOPS
FILTER OFF THE GRAYISH PRECIPITATE
WASH THE PRECIPITATE ON FILTER PAPER WITH WATER, AND
LET DRY NATURALLY
MIX PRECIPITATE WITH 5% OF ITS WEIGHT OF DEXTRIN AND
ADD WATER TO MAKE A PASTE

You can April-fool your friends with trick matches doctored with a preparation made as shown in the drawings. When a match is struck, a long serpent of ash writhes out of it, to the amazement of your victim

precipitated red mercuric oxide into a strong solution of potassium iodide.

Start with a clean beaker containing a strong, almost saturated solution of potassium iodide in water. Stir the dried red mercuric iodide into it, a pinch at a time, until no more will dissolve. Then filter the solution. The clear, pale-yellow liquid that results really contains a distinct chemical compound, formed by the combination of the iodides of potassium and mercury.

If you have followed directions, you should now be able to float glass marbles, pebbles, and fragments of brick in the solution. In case your experiment fails, the solution held too little potassium iodide or mercuric iodide, and you will have better success with a stronger one. Notice the brilliant array of colors that the fluid exhibits, by strongly refracting the light that falls upon it. The solution has been used in mineralogy for determining the specific gravity of rocks, for separating minerals of different densities, and for determining the refractive index or light-bending power of crystals.

Pharaoh's serpents—the Fourth-of-July pellets that burn to make a voluminous ash—can be prepared in several ways. One good one is to add a solution of sodium or potassium sulphocyanide (these compounds are also known both as sulphocyanates and as thiocyanates) to a solution of mercuric chloride, until no further precipitate forms. Filter off the grayish-white precipitate, which consists of mercuric sulphocyanide. Wash it on the folded filter paper with plenty of water, and then let it dry at room temperature. Do not try to hasten the process with a drying oven, or it may convert itself spontaneously into ash in the process.

To make trick April-fool matches with your "snake" composition, mix it with five to ten percent of its weight of dextrin, and enough water to form a paste. While this paste is still moist, apply it to the heads of the matches. If the match heads are red, a little red household dye mixed with the paste will help to camouflage it. Anyone not in on the trick will get a surprise when he strikes one of the doctored matches, for the head will burn to produce a "snake" an inch or more long. The same paste may be molded into pellets to form the conventional Pharaoh's serpents.

A small stock of pure mercury, or quicksilver, may well be one of your most prized laboratory possessions. Though it costs little more by weight than many other chemicals,

its great density means that your money will buy proportionately less of it by volume. Nevertheless the investment will enable you to do fascinating stunts with this freakish metal.

One interesting and beautiful experiment you can perform with quicksilver requires no more than you can obtain from a discarded thermometer. Close one end of a piece of glass tubing, a quarter or half inch in diameter, by tying several thicknesses of closely woven cloth over it. Place a drop of mercury in this tubular basket. Suspend the tubing vertically in a test tube filled with silver nitrate solution, made by dissolving about a gram of silver nitrate in ten or fifteen cubic centimeters (three or four teaspoonfuls) of water. Use distilled water, by preference, in making up this solution. If you use tap water, chemical impurities in it are likely to produce a white precipitate of silver chloride, which you will have to remove by filtering before you use the solution.

Beautiful crystals of pure silver form a treelike growth before your eyes in this striking test

Soaking through the cloth, the silver nitrate solution comes in contact with the mercury. Before your eyes, a beautiful treelike growth of metallic crystals appears. The glistening formation extends downward into the silver nitrate solution, below the cloth, and consists of crystals of pure silver.

If you are fortunate enough to have a fair quantity of mercury at your disposal, you can demonstrate its extraordinary buoyancy, which far exceeds even that of Thoulet's solution. Iron nuts, brass screws, and copper fittings will bob about on the surface of a pool of mercury, without sinking. The liquid metal, thirteen and a half times as heavy as water, floats them with ease.

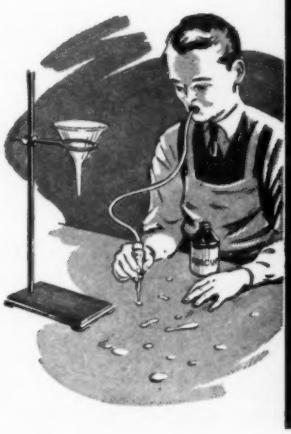
In case your supply of mercury seems dull and lifeless, and leaves a trail of scum behind it when rolled around the bottom of a beaker, it is contaminated with impurities. Usually the scum or dross consists of a film of oxide of mercury, grease, and other foreign matter clinging to the surface of the larger globules of mercury. Metals such as zinc and lead may also be present as impurities. Contaminated mercury may easily be cleaned, however, by one of several methods.

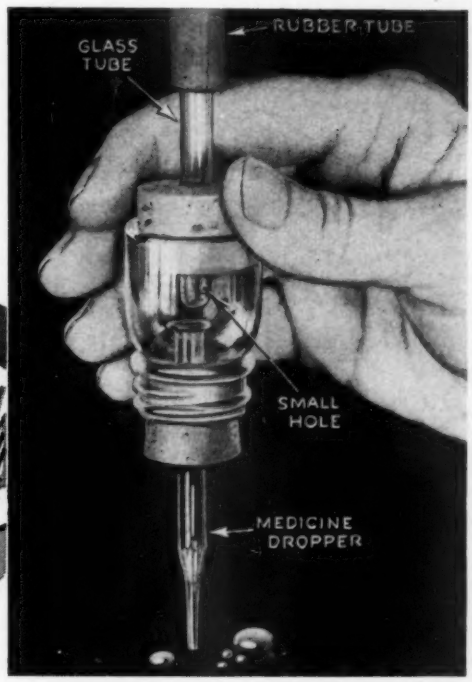
The simplest way is to prick about ten or twelve holes, with a needle, in the center of a sheet of filter paper. Place the twice-folded paper in a funnel, as for ordinary filtering, but do not wet the paper. Pour the mercury into the filter. If there is enough mercury to fill the paper cone, the pressure will be sufficient to force the quicksilver through the holes at the bottom, and it will emerge bright and clean.

While this scheme removes ordinary dross, it does not get rid of baser metals amalgamated with the mercury. These may be eliminated by a simple washing process, in which as large a surface of the mercury as possible is exposed to a nitric acid solution of eight to ten-percent strength.

To assemble a handy mercury purifier for this purpose, tie a single thickness of silk cloth, with a piece of string, over the end of a plain *(Continued on page 244)*

Droplets of mercury spilled on the table are easily picked up with this simple device. When you suck on the tube, quicksilver hops obediently up into the bottle





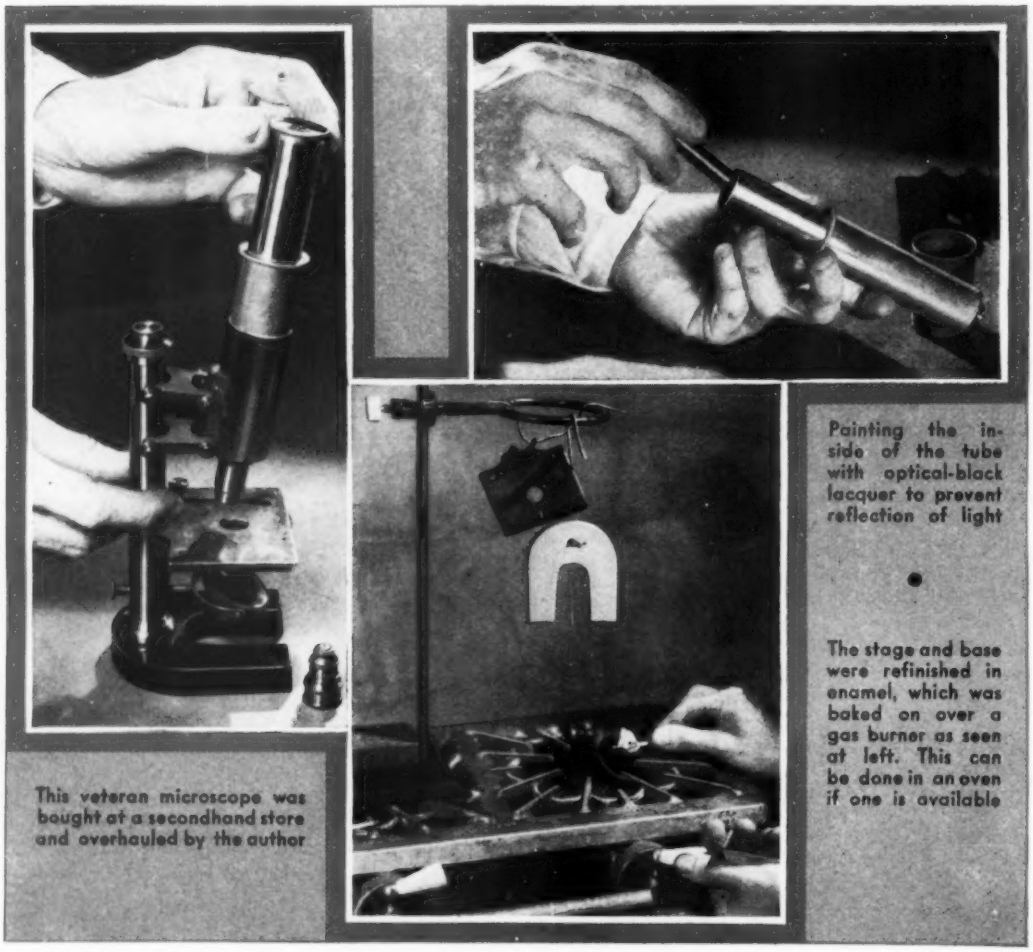
Reconditioning an

ILLUSTRATES CARE OF

EVERYBODY, at some time or other, has the urge to take a watch or clock apart and see "what makes it tick." This fascinating and instructive experiment is not one to be carried out on your pocket timepiece or the mantel clock, a safer subject being a retired alarm clock or a worn-out dollar watch. Similarly, you can learn a lot about the fundamentals of microscope construction, and the care of your regular instrument, by dismantling and reconditioning an old-timer—one of the brassy veterans that are still to be found by the hundreds in pawn shops and secondhand stores.

Although this article is largely an account of how such a veteran microscope was overhauled and put into fairly good working condition, it goes a bit farther by pointing out several processes that can be used in repairing other kinds of instruments, such as cameras, and in building accessory microscope equipment.

The other day, I wandered into the shop of a dealer who handles used photographic and optical equipment, and came out with the microscope shown in the illustrations. It is in instrument of German manufacture, age unknown but obviously sufficient to make it eligible for a pension. It takes a standard eyepiece, but the two objectives that came



This veteran microscope was bought at a secondhand store and overhauled by the author

Painting the inside of the tube with optical-black lacquer to prevent reflection of light

The stage and base were refinished in enamel, which was baked on over a gas burner as seen at left. This can be done in an oven if one is available

Old Microscope

MODERN INSTRUMENTS

with it do not have the Society threads now used universally on standard laboratory and research microscopes. Magnification, as nearly as has been determined, runs from about 150 to well over 500 diameters. The definition, particularly with the lower-powered objective, is excellent. With the higher powers (up to about 550 X), stained bacteria can be seen clearly.

The program of rejuvenation called for a complete dismantling and thorough cleaning, followed by refinishing of the parts requiring it, the addition of any missing items, and the making of one or two auxiliaries that would extend the possibilities of the instrument.

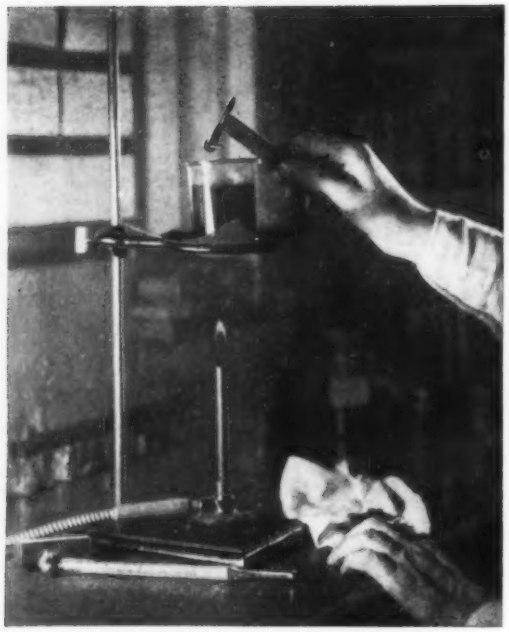
Since the complete overhauling of a microscope objective is a job for an experienced lens man, no attempt was made to dismantle the two objectives that came with this instrument, other than to unscrew the various segments so the lenses could be cleaned. Many objectives can be separated into several units without disturbing the centering or other adjustment of the lens elements. In this case, one of the objectives is of the divisible type, the magnifying power being controlled by unscrewing or replacing elements.

The rejuvenated microscope in use. Reconditioning such an instrument teaches an amateur how to care for his regular microscope

To clean an objective or eyepiece lens, first use a small, soft, and perfectly clean artist's brush to pick off any lint or particles of dirt that may be present. Then use lens tissue paper or a soft, well-laundered cotton or linen handkerchief to finish the job. Wipe the lens surface lightly, and in a circular motion. If necessary, breathe on the glass to moisten it; but never use a cloth or paper wet with any liquid such as water or alcohol, except in very extreme cases; and then do not let the liquid run between the lens and mount.

Further dismantling of the microscope included removing the body tube, separating the pillar and horseshoe-shaped base, taking out the fine-adjustment screw, and removing other parts so they could be cleaned. In this particular instrument, the body tube slides in an outer, split tube that is in turn supported by two parallel arms having pointed bolts engaging shallow holes in the pillar, and a brass block soldered to the outer tube. The fine-adjust-

By
MORTON C.
WALLING



Brass parts can be given a durable oxide finish by dipping in a copper carbonate-ammonia solution

ment screw works against a projection of the block that enters a slot in the pillar. Coarse adjustment is effected by sliding the one tube inside the other with the fingers.

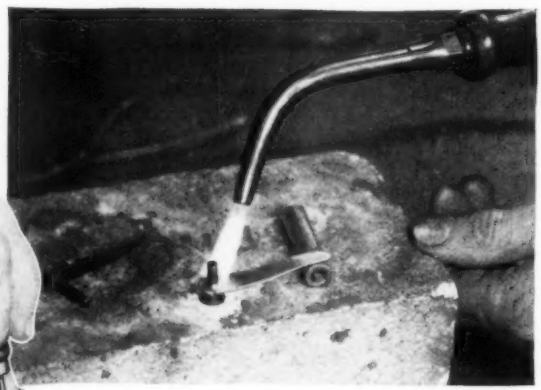
The tubes and pillar were in fairly good condition, the gold lacquer that originally was used to finish them being practically intact in spite of its age. So it was decided that they would need only cleaning with soap and water. The part of the body tube that slid inside the outer tube was not lacquered, and required cleaning and polishing.

There are numerous ways to clean brass. If the surface is considerably blackened, much of this can be removed with vinegar or twenty-eight-percent acetic acid in which a considerable amount of table salt has been dissolved. Immerse the pieces in this solution, or swab it over them with a cloth, rubbing well. Wash the metal in clean water, dry, and polish with some good brass polish. Usually, if you have a good polish, the salt-and-vinegar treatment is not required.

The polished surface can be preserved by lacquering. For this, you can use a good grade of transparent brushing or spraying lacquer. Spraying gives the smoother finish, but requires a paint gun for proper application.

Preliminary observations through the microscope had revealed that definition suffered because of stray light reflected from the inside of the body tube. The trouble was caused by the disappearance of the original dead-black coating, and was easily remedied by painting the inside of the tube, except where the eyepiece slides into it, with optical lacquer. This is a jet-black lacquer that dries with a dead-mat, nonreflecting surface. You can make your own optical lacquer simply by diluting some brushing lacquer with about four times its volume of thinner, and adding a generous amount of dry lampblack or drop black. Stir until evenly blended, and make a test application on a piece of scrap metal. If the lacquer does not have enough covering power, add more pigment. If it dries with a shiny surface, add more thinner and pigment.

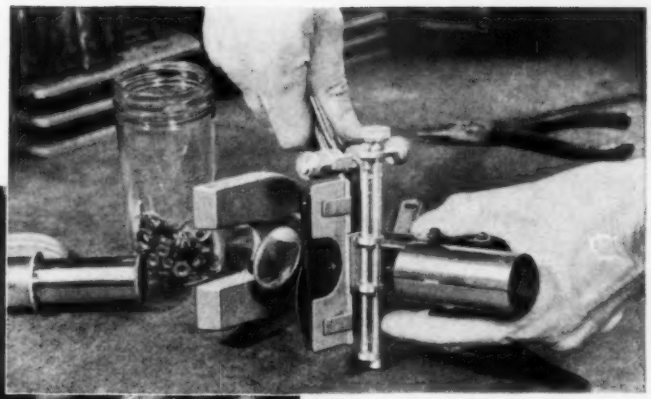
The foot of the microscope was, like so many of these old instruments, covered with a black paint that someone had daubed on with total lack of artistry. This was removed by

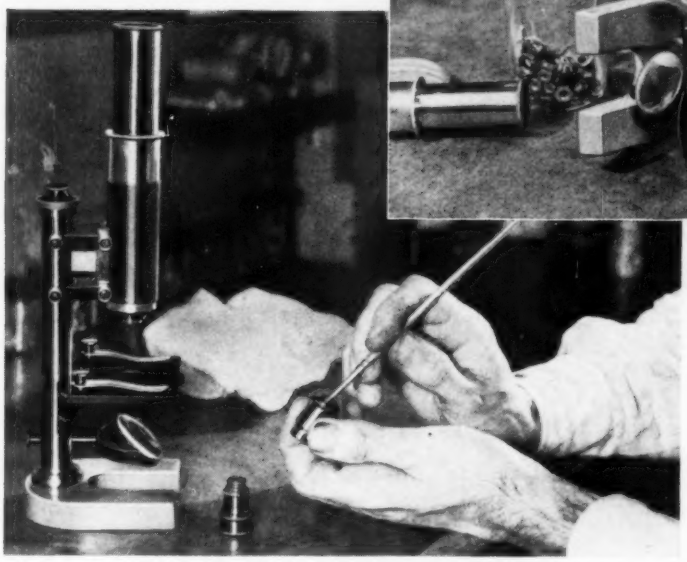


Here a new stage clip is being made by soldering a metal strip to a pin. One of the original stage clips can also be seen

At the left, the substage diaphragm is being reassembled after finishing. The stage has been enameled

Right, a homemade mechanical stage is added to improve the performance of the microscope. Below, cleaning objectives with an artist's brush and lens tissue or a handkerchief



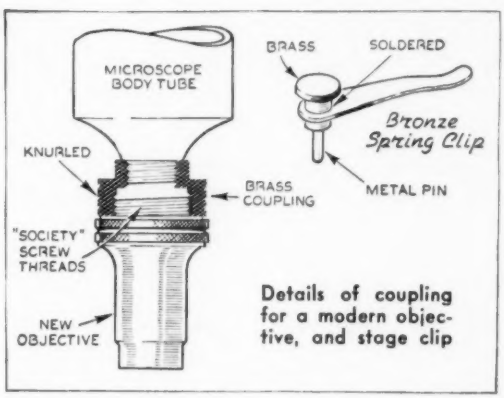


washing with lacquer thinner (regular paint remover could have been used as well), and the metal was cleaned up with steel wool until it was uniformly bright. Then it was refinished with bake-on enamel. The bake-on enamel used is a finishing material containing plastic pigment which, under the action of heat, fuses into a hard, smooth finish that is much more durable than ordinary lacquers or paints. It costs around eighty cents a quart, and is supposed to be applied with a spray gun, but can be put on small areas quite satisfactorily with a camel's-hair brush. After drying in air for fifteen minutes to an hour, the lacquer is subjected to about 200 degrees F. for at least two hours. Although a suitable oven is ideal for this, small objects such as the microscope parts can be baked very well by suspending them 12" or so above a gas or oil stove burner whose flame is turned low. If you want to, you can use a twenty-cent oven thermometer to check the baking temperature.

The stage of the microscope was found to be brass that long since had lost its upper-surface finish, if it ever had any. The stage was cleaned with steel wool, and refinished with black bake-on enamel, which made it look surprisingly handsome.

This microscope has a substage-diaphragm arrangement consisting of a rotatable disk with several holes of different sizes. Before applying enamel to the underside of the stage, the screw holes used to attach the diaphragm and click arrangement were plugged with match sticks whittled down to size and turned into the threads. These were removed after the enamel had air-dried, but before baking.

The brass substage diaphragm and some of the other parts did not lend themselves very well to refinishing by enameling, so it was decided to blacken the metal chemically. This kind of work can be done as follows: Dissolve a quantity of copper carbonate in ammonia water (ammonium hydroxide). This produces a brilliant blue solution. If you cannot obtain dry copper carbonate from the drug store, you can make it by treating a solution of copper sulphate (blue vitriol) with a solution of sodium carbonate (washing soda). The copper carbonate, being insoluble in water, will precipitate out. Let the flask or jar containing it stand until the *(Continued on page 242)*



Details of coupling for a modern objective, and stage clip

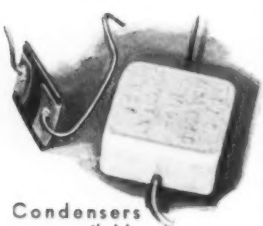
Radio

SELECTION of the correct power filter to prevent man-made static from entering a set through the house wiring is simplified by a new testing instrument. Housed in a compact steel case, the unit contains five efficient filter circuits, connected to a rotary tap switch so that any one may be selected by a flip of the control knob. When the instrument is plugged into the house-lighting circuit and then connected to the set, the switch is turned until the operator locates the filter circuit that best cuts down a specific power-line noise. Electric razors, vacuum cleaners, and other electric devices used in the home can also be connected to the selector to determine which filter cuts out the noise they make in radio sets that are operated near-by.

Connected between radio and house wiring, this device selects the proper filter to eliminate radio noises

Curved Mica Condensers Have High Stability

FIXED mica condensers are now available in a new curved form. According to the manufacturer, the curved shape materially increases their overall stability and results in maintaining their original capacities, regardless of variations in atmospheric temperature and humidity. In making the new-type unit, specially treated silver is first sprayed on the mica, after which the latter is put under pressure and then vacuum-treated to create a solid mass and eliminate moisture from the mica. Contact to the silver plates is made by pieces of metal foil.



Condensers are available in two styles

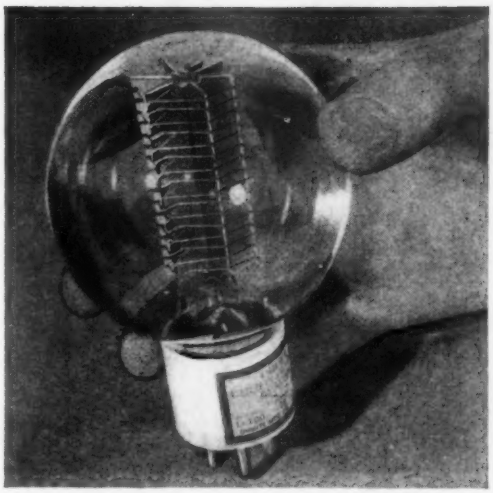
Radio Experimenter's Kit Holds Clips and Clamps

SEVENTY-SEVEN separate items are contained in a handy kit of miscellaneous clips, clamps, and other small accessories, recently marketed for radio experimenters, set builders, and service men. Neatly stored in compartments in a cardboard box having a sturdy hinged cover, the kit includes both steel and copper clips, rubber insulators, ground clamps, and test prods, housed in a convenient form either for use on a workbench or to carry along when doing work away from the shop.

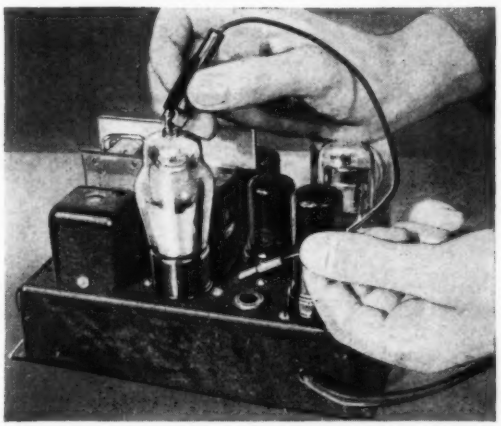
Aids for Amateurs

Dummy Antenna Aids in Tuning Transmitters

"HAM" operators will find good use for a new dummy antenna in the form of a resistor housed within a gas-filled glass tube. First, the unit provides a handy means for tuning up an amateur radio transmitter to maximum efficiency, by making possible accurate measurement of the radio-frequency power output, and therefore the efficiency, of the final amplifier, as well as of preceding stages. Second, it can be employed, while tuning up the transmitter, to keep the signal off the air and eliminate interference. Resistance values of seventy-three and 600 ohms are available to match concentric, twisted-pair or open-wire antenna leads.



Housed in a gas-filled bulb, the resistor permits transmitter-output measurements while off the air



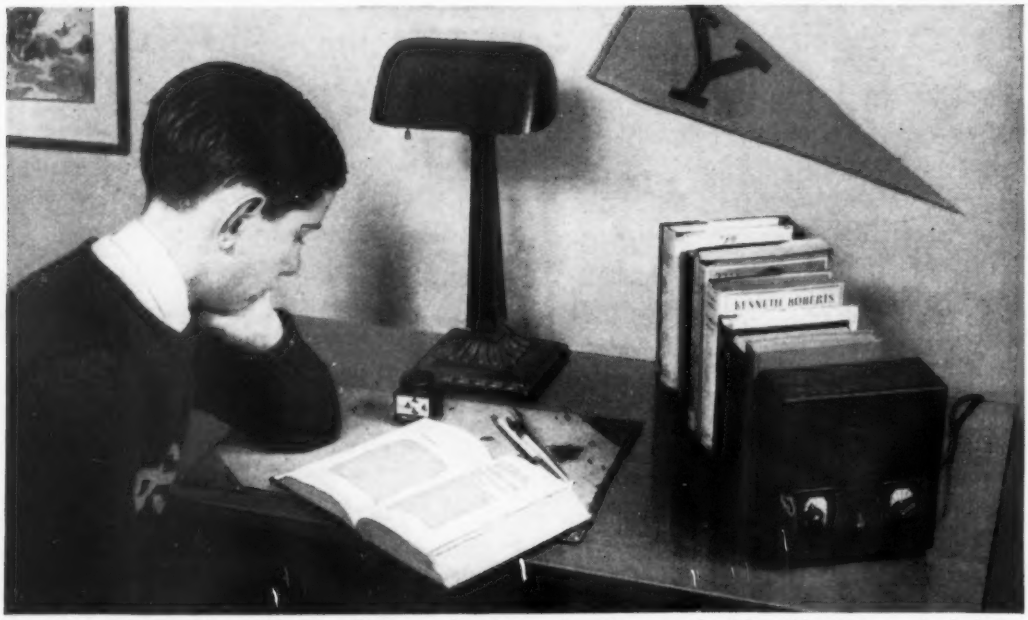
New Clip for Grid Caps Fits Any Type Tube

A NEW grid-cap connecter just introduced consists of a clip with spring jaws specially designed to give a firm grip on radio-tube grid caps of all sizes, a rubber insulator for the clip, and a ten-inch, rubber-covered wire terminating in a standard phone tip. The clip, placed on a tube cap in either a horizontal or a vertical position, will not slip off the cap, no matter how hard the tube itself is jostled. However, the makers claim that the clip will not injure or break the grid cap, for when the clip itself is struck accidentally, it instantly pulls loose without damaging the cap. The unit is pictured in use above.

Ajustable Jacks Support Chassis During Repairs

REPAIRING and adjusting a radio are simplified when the chassis is supported on the jacks and illuminated by the gooseneck lamp shown in the photograph below. Made of metal, the jacks are adjustable for height by means of thumbscrews.

Thumbscrews hold the jacks at any convenient height



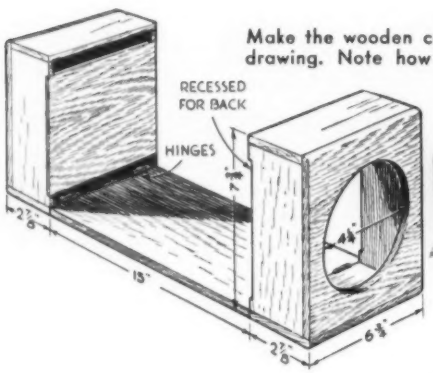
Decorative and doubly useful, the efficient radio shown above is a worth-while addition to one's desk top

BUILD THIS

Book-End Radio for Your Den

COMBINING usefulness with novelty, this folding book-end radio provides something new and novel in the design of radio cabinets. It is a set that should appeal to every one who builds radio receivers as a hobby.

The circuit chosen uses four of the latest all-metal electric tubes and will operate equally well on either alternating or direct current. Although not a tuned-radio-frequency receiver, this set is just as sensitive and selective, and is cheaper to build because only one coil and one tuning condenser are needed. A regenerative detector built around one of the new radio-frequency pentodes is used in the first stage, and is resistance-coupled to one of the new triodes, which is in turn resistance-coupled to a 25A6 output pentode. The fourth tube, the 25Z6, rectifies the current for the receiver, changing the al-



Make the wooden cabinet to dimensions in the drawing. Note how ends fold in for carrying

By ARTHUR C. MILLER

ternating house current to direct. However, when plugged into a D.C. outlet, this tube merely acts as a resistance.

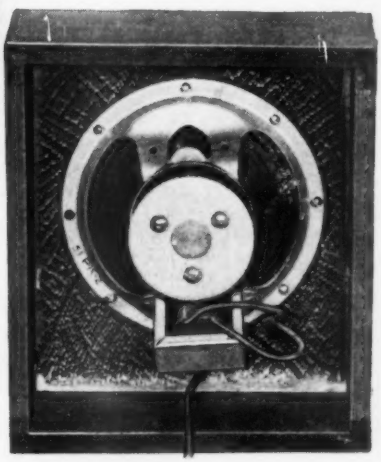
Regeneration is controlled by a 20,000-ohm variable resistor, which is connected across the tickler coil. The slider, or arm, of this variable resistor is grounded to the chassis through a .0005-mfd. mica condenser. A 6-mh. choke is inserted in the plate lead of the detector tube in order to keep radio-frequency currents out of the audio stages, and also to add to the smoothness of the regeneration control. The grid-leak detection, chosen because of its greater sensitivity over the usual bias method, consists of a one-meg. fixed resistor in parallel with a .00025-mfd. mica condenser.

A plug-in coil must be used with this circuit since a standard A.C.-D.C. antenna coil has no tickler winding. This coil is tuned by a .00036-mfd. single-gang variable condenser. Inserted in the ground lead of the primary winding on the coil is a new type of tuning control, which may be best described as a selectivity control. It consists of one of the new ultra-flat tuning condensers using molded-plastic insulation, and is mounted on the front panel behind the plug-in coil, between the tuning condenser and the 20,000-ohm variable resistor.

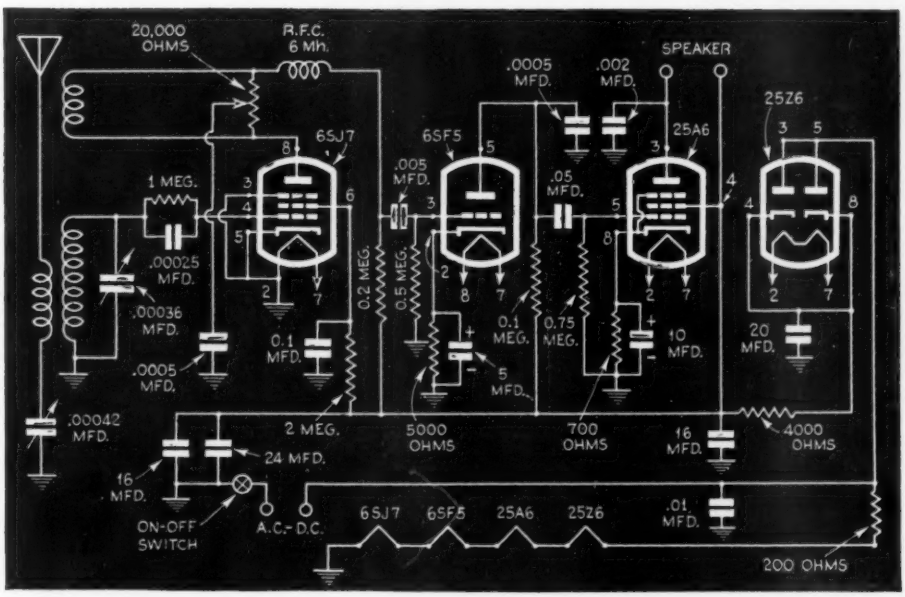
Decreasing the capacity of this condenser increases the selectivity of the receiver. At its minimum setting, it will cut down the volume by decreasing the coupling of the primary and secondary coils. This is especially useful when tuning to a strong signal.

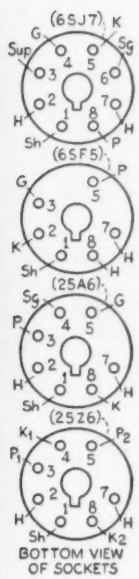
A .0005-mfd. and a .002-mfd. mica condenser are used in the plate leads of the first and second audio stages, and help to cut down feed-back and unwanted oscillation, which would cause distortion in the loudspeaker.

To avoid any excessive hum that might be caused by the compactness of the circuit, a



The chassis end of the unit and, at right, the loudspeaker end. Diagram below shows the wiring





total of 76 mfd. should be used for filtering the rectified direct current. The filter circuit is made up of four electrolytic condensers, one 20 mfd., two 16 mfd., and one 24 mfd.

The cabinet is easy to build, and may be made at home from any kind of wood, such as pine, walnut, or mahogany. After careful sandpapering—with the grain, not against it—the finished cabinet can be given one or two coats of stain, depending upon how dark a finish is desired. Once these coats have thoroughly dried, a thin layer of shellac can be applied and rubbed down to kill some of the gloss. Rubber feet will raise the book ends and provide room for the speaker cord that runs from the compartment box at one end which houses the chassis to the compartment at the other end which houses the 5" permanent-magnet speaker. A built-in aerial is used so that no antenna or ground connections are needed for good reception.

LIST OF PARTS FOR BOOK-END RADIO

One 6SJ7 tube.
One 6SF5 tube.
One 25A6 tube.
One 25Z6 tube.
Antenna condenser, .00042 mfd.
Tuning condenser, .00036 mfd.
Electrolytic condenser, 24 mfd., 150 v.
Electrolytic condenser, 20 mfd., 150 v.
Two electrolytic condensers, 16 mfd., 150 v.
Electrolytic condenser, 10 mfd., 25 v.
Electrolytic condenser, 5 mfd., 25 v.
Mica condenser, .0005 mfd.
Mica condenser, .0002 mfd.
Tubular condenser, .1 mfd.
Tubular condenser, .02 mfd.
Tubular condenser, .005 mfd.
Tubular condenser, .05 mfd.
Tubular condenser, .002 mfd.
Line-cord resistor, 200 ohm.
Resistor, 1 meg., ½ watt.
Resistor, 2 meg., ½ watt.
Resistor, ½ meg., ½ watt.
Resistor, 750,000 ohm, ½ watt.
Resistor, 200,000 ohm, ½ watt.
Resistor, 100,000 ohm, ½ watt.
Resistor, 5,000 ohm, ½ watt.
Resistor, 4,000 ohm, 1 watt.
Resistor, 700 ohm, 1 watt.
Switch and volume control, 20,000 ohm.
Radio-frequency choke, 6 mh.
Six-prong, plug-in coil.
Miscellaneous:—Speaker, four midget octal sockets, aluminum chassis, cabinet, wire, etc.

Beginner's

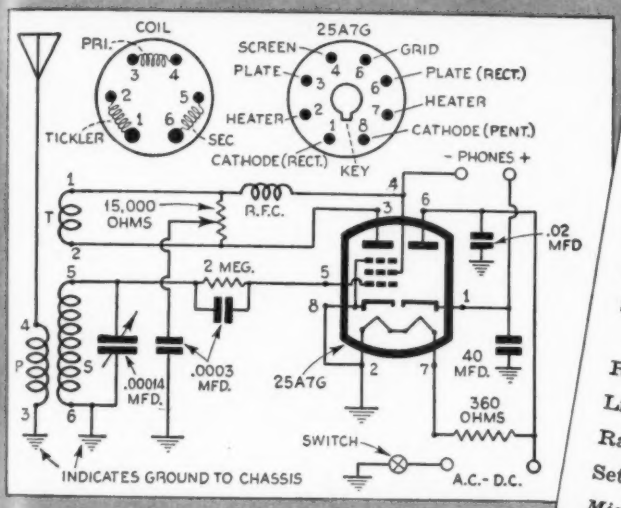
This sturdy set is compact and has a range up to 1,000 miles

WITH a broadcast-band range up to 1,000 miles, the one-tube, all-electric, A.C.-D.C. receiver illustrated is designed especially for beginners. It requires a minimum of parts, costs little to build, and is easy to assemble and wire.

The set is built around one of the new bantam-type, midget, octal-base tubes. This particular tube, the 25A7GT, is really a pentode tube and a half-wave rectifier in one. The pentode section is used as a regenerative detector.

In spite of the compactness of the steel cabinet (5" by 4" by 3"), it is an easy matter to mount and wire the parts, as the top and bottom panels can be unscrewed and taken off. The six-prong plug-in coil, the insulated earphone terminals, and the tube are all mounted on the top panel. The .00014-mfd. tuning condenser and the 15,000-ohm wire-wound combined regenerative control and switch are mounted on the front panel.

One-Tuber IS ALL-ELECTRIC



All connections are clearly shown in the diagram. Note particularly the negative phone connection to pentode-tube screen, and absence of a ground

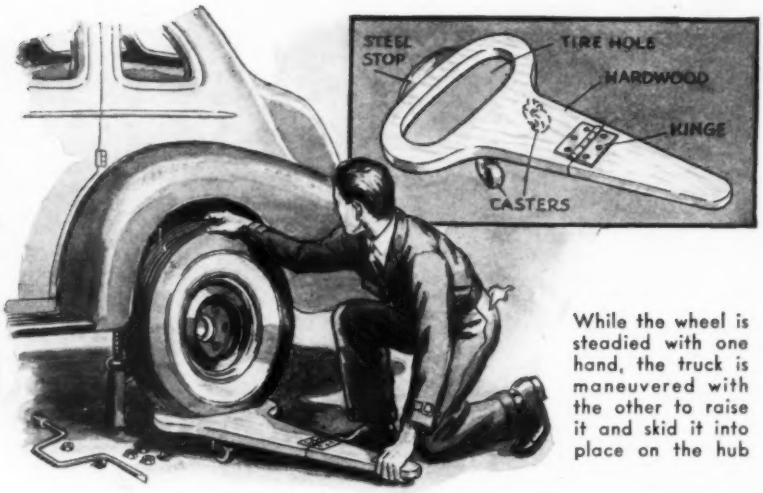
LIST OF PARTS

One 25A7GT tube.
Tuning condenser, .00014 mfd.
Electrolytic condenser, 40 mfd.
Tubular condenser, .02 mfd.
Two mica condensers, .0003 mfd.
Switch and variable resistor, 15,000 ohm.
Resistor, 2 meg., ½ watt.
Line cord, 360 ohm.
Radio-frequency choke, 2.5 mh.
Set of six-prong coils.
Miscellaneous:—Cabinet (steel), octal-tube socket, six-prong-coil socket, two insulated banana jacks and plugs, earphones, wire, solder, etc.

Bottom view of the chassis, below, indicates how parts are arranged. Both top and bottom panels can be removed to facilitate the wiring

A very simple filtering system, consisting of only one high-capacity electrolytic condenser, is used. The earphones are connected in series with the cathode of the rectifier, and the reader should note that the screen of the pentode tube is connected to the negative terminal of the phones instead of the positive. No ground should be used with this receiver, as circuits of this type are grounded through the house wiring. A rubber grommet should be used to protect the line cord where it passes through the steel cabinet, otherwise the sharp metal sides of the hole may cut the insulation and cause a short circuit. Should the set hum, reverse the phone leads.

Tricks for Car Owners



While the wheel is steadied with one hand, the truck is maneuvered with the other to raise it and skid it into place on the hub

Homemade Dolly Helps Put Wheel on Hub

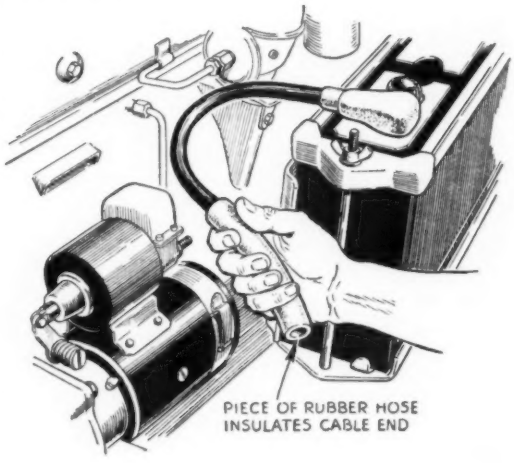
LIFTING automobile wheels and maneuvering them into place on a car hub is made easy by a simple lifter consisting of a piece of hardwood slotted at one end and mounted on caster wheels. When putting on wheel, the lifter is placed close to the hub and the wheel is rolled into the slot. With one hand steadying the wheel, the other operates the unit's hinged handle to hoist the wheel and skid it into place, the casters acting as pivots. The hinged handle permits the lifter to be folded for easy storage. If storage space is not at a premium, this feature can be omitted, simplifying the construction.—C.H.W.

Caster Keeps Garage Door From Scraping the Ground

SAGGING garage doors that scrape along their bottom edges when being opened or closed, are soon pulled out of shape and require replacement. To prevent this, fasten a roller or heavy caster to the bottom of the door to support the door's weight and make it swing more easily. Saw off the caster shaft and bolt or weld the roller to an angle iron, as shown above. Of course, a smooth rolling surface is desirable.—C.E.B.

Rubber Tubing Insulates End of Battery Cable

IN REPAIRING a car starter motor, sparking, caused by the bare end of the battery cable touching some metal part, can be prevented by slipping a short length of rubber hose over the cable end as soon as it is removed from the starter.—R.L.



SNAPSHOTS at NIGHT are simpler and surer than ever with

EASTMAN'S NEW HIGH SPEED FILM

Kodak Super-XX is about four times as fast as ordinary film

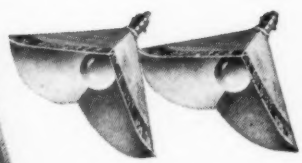
THOUSANDS are clicking away indoors these evenings, as confident of getting good snapshots as though they were taking pictures outdoors in the sunlight. That's how simple, how sure, nighttime picture taking has been made. With fussy posing out, even the inexperienced picture taker gets lively, informal, true-to-life snaps. You need less light indoors than ever before; and you use any camera that takes the new high speed film, Kodak Super-XX—even an inexpensive Brownie.

FREE BOOKLET . . . A single reading, and you're ready to make nighttime snapshots you'll be proud of. Non-technical text, interesting photographs, easy-to-understand diagrams, and light arrangements. At your dealer's . . . Eastman Kodak Company, Rochester, N.Y.

ALL YOU NEED

1. Your present camera loaded with the new Kodak Super-XX Film

2. A couple of inexpensive Mazda Photoflood lamps in Kodak Handy Reflectors



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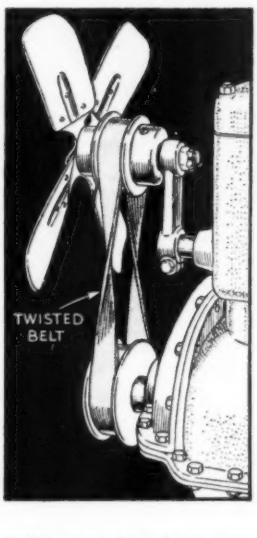
Name
Address

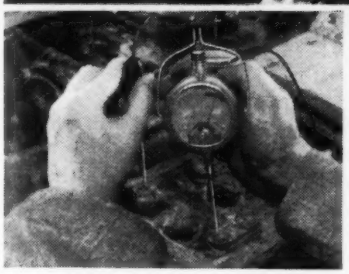
Filling Scratched Places Without Spotting Finish

SCRATCHES and chipped spots on the finish of a car, always entering wedges for the damaging effects of rust, are hard to repaint without leaving the finish uneven and spotty. A better way to do the job is to clean the marred surface with gasoline, and then rub in a small amount of paint with a soft cloth, pressing firmly but not too heavily. The paint will fill in the scratches, but can easily be wiped off the surrounding surfaces to prevent unevenness.—A.C.S.

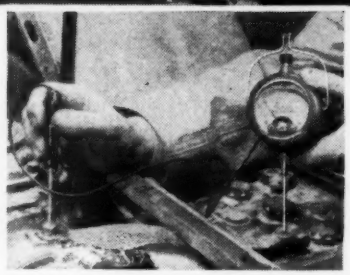
Twisting Gives Tension to Loose Fan Belt



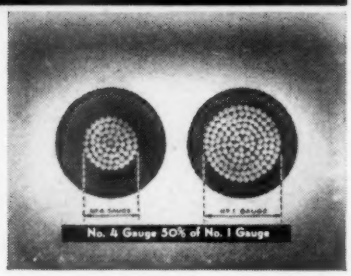
NOT long ago, I found that the motor of my car was running hot and finally traced the cause to a loose fan belt. When I tried to fix this, I discovered that the tension adjustment had been tightened to the limit. Being unable to replace the belt immediately with a new one, I found a solution to the problem by giving the flat belt a twist, as shown in the illustration reproduced at the left. This tightened the belt tension sufficiently to allow me to drive the car many miles before a replacement was necessary, thereby giving me considerably more service from the belt than I would otherwise have had.—L.A.B.



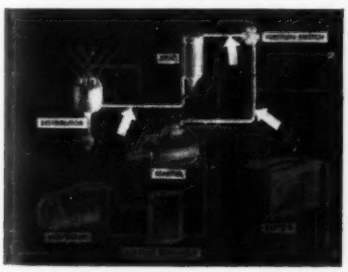
THAT a hydrometer reading of a battery is not the real indication of the battery's condition? This reveals only the chemical condition. To find the power available, it is necessary to check the battery under load with a low-reading voltmeter.



THAT voltage loss—caused by excessive resistance in cables, connections, or parts—may make the difference between a car that *will* start and a car that won't start? Battery cables and ground straps must be full size and free from corrosion.

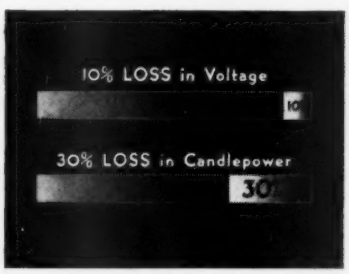


THAT some battery cables have only 50% as much copper in the core as the standard No. 1 gauge cable—and, therefore, have only 50% of the current-carrying capacity? All Packard battery cables are No. 1 or No. 0 gauge.



THAT a common cause of voltage loss and unsatisfactory performance in the primary ignition circuit is excessive resistance in the cables? New cables that are too small will not remedy this condition—they must be of proper size.

THAT cracked and oil-soaked insulation of the spark plug wires allows electricity to leak away and robs your car of pep, power and economy? *Packard 440* ignition cable has a secret-formula protective sheath that seals in the high voltage.



THAT a 10% loss in voltage in the lighting circuit causes a 30% loss in candlepower? Because of this—and because old, worn or undersized cables are a dangerous fire hazard—good wiring is a very important safety factor.

AND DO YOU KNOW THAT—?

Packard Electric is the only cable company that trains mechanics with a program of Service Films and Service Instruction Manuals on Re-Wiring. This means that when you drive into a service station or garage where Packard cable is used, you are sure of getting the highest quality cable, installed by mechanics who know how. Packard Electric Division, General Motors Corporation, Warren, Ohio.

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KEEP TOOLS IN TRIM—

MAKE MODELS RUN SMOOTH

MOBIL HANDY OIL

This oil won't "gum up" your models. It's light—penetrating—lubricates household electrical appliances, sewing and washing machines, bicycles, toys. Fine for automobile generators, hinges, etc. Convenient wall bracket free with every can.

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Quiet Car Engine

MOBIL UPPERLUBE

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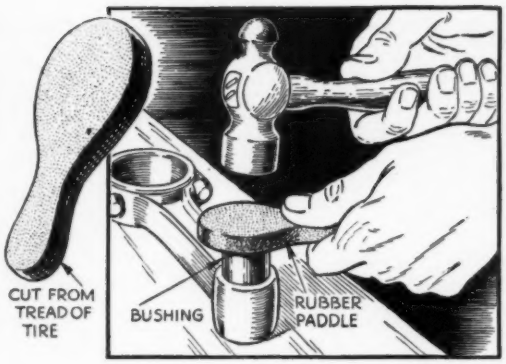
MOBIL HYDROTONE · MOBIL SPOT REMOVER

SOCONY-VACUUM

BY THE MAKERS OF MOBILOIL

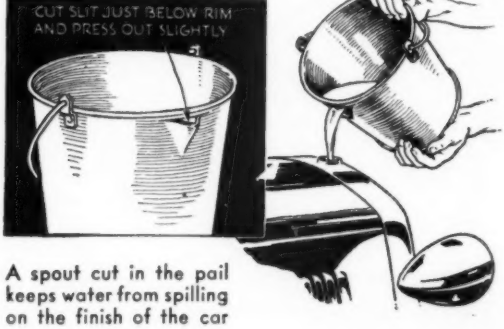


Paddle Cut from Old Tire Is Handy Hammer Cushion

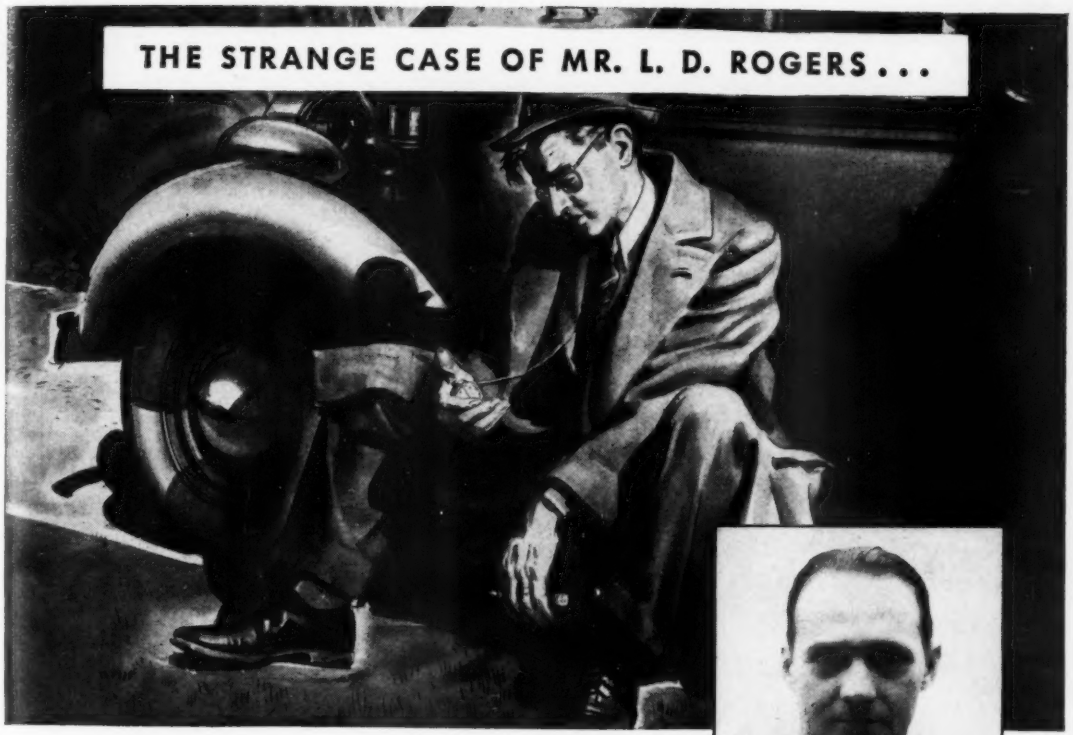
A PADDLE-SHAPED piece cut from an old tire tread forms a handy addition to a motorist's garage tool kit. It can be used to advantage in driving bolts or bushings, as pictured above, where direct blows of a hammer would batter the rims or threads of the metal part. The tire-tread paddle is also useful for repair work on dents in car fenders. If the rubber is cut from the tough, reënforced part of the tire casing, it will stand up well under the heaviest of hammering.—A.H.W.

Spout Improves Water Pail

ANY water pail used for filling an automobile radiator can easily be improved by forming a simple pouring spout near the top, as demonstrated in the illustration below. A small slit is cut into the side of the pail directly below the rim, and the part below the slit is bent outward to form a spout. Water then flows through the spout into the radiator hose in a small, controlled stream, instead of slopping over the radiator rim and running down over the car finish.—J.K.L.



A spout cut in the pail keeps water from spilling on the finish of the car



"It always happened when I was in a hurry!"

MR. L. D. ROGERS
Monroe, La.

"Four months ago I began having starting trouble—and it *always* seemed to happen when I was in a hurry!

"I took my car to one garage after another. Each time they'd recharge the battery and tell me it was O. K. And each time I'd have another starting failure in less than two weeks. It seemed even the most experienced mechanics couldn't locate the REAL trouble.

"Finally, a friend told me about ***Willard Starting Service.*** Doubting but desperate, I agreed to try once more. I went to your Willard Dealer here.

"Believe it or not, in 15 minutes he checked the ENTIRE electrical system of my car...located the trouble (which wasn't in the battery at all) and fixed it so it stayed fixed. In my opinion you have made a real contribution to American motoring with this new ***Willard Starting Service.*** It's great!"

Here's How It Can Protect You

Your Willard Dealer has a new instrument (called the *Willard Electrical Check*) that "x-rays" the entire starting system—under actual load conditions. With it he can locate worn or undersize cables, loose connections, faulty wiring, voltage regulators and generators that need adjustment . . . the things that cause most starting failures.

We offer you this ***Willard Starting Service,*** *as our way of EARNING your patronage. It will save you money—save you trouble—and relieve you of worry . . . come in and try it.*

Your Willard Dealer

You can identify our station by this sign.

If you are interested in the "why" and "how" of the instrument that makes this service possible, send a letter or postcard to Willard Storage Battery Company, Dept. C-4, Cleveland, Ohio.

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Putting a wax polish on your car isn't the long tough job it used to be. Far from it! Now, with the marvelous new Du Pont Speedy Wax, you can clean the finish and give it a wax polish in one easy operation. You do *both* jobs at the same time—easily and quickly. And what a long-lasting lustre you get! Speedy Wax is fine for all types of car finishes. Try it.

• • •

Sample for you . . . We'll gladly send you a generous sample of Speedy Wax—enough for fenders and hood. Just send 6¢, to help cover postage, to Du Pont, Dept. SP-1, Wilmington, Delaware.

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Full-Size Patterns of Cabin Cruiser

IF YOU intend to build our new 17′ cabin cruiser, you will find that full-size patterns will make your work much easier. The set costs $2.50 and includes patterns of all the frames (including the two transoms), the main deck beam, and the stem. The cabin beams are not included because these vary slightly in individual cases.

Blueprints of the cruiser, drawn to scale, cost an additional $1.00. If you wish both the prints and the patterns, the total cost is $3.50. Patterns are drawn to order by the designer, which takes a week or two.

A complete list of our blueprints will be mailed upon receipt of a stamped, self-addressed envelope. If you are interested only in boats, ask for the special boat leaflet. A partial blueprint list follows:

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Cabin Cruiser, 17′ long, for use with outboard or inboard drives, 356-357-358-359 ..... $1.00
Camper's Utility Boat, 11′ 2″ long, canvas-covered, for outboard motor or rowing, 281-R ..... .50
Canoe, 16′ canvas-covered kayak; can be used with sail, 192-193-194-R 1.00
Canvas-Covered Duck Boat, 13′ 6″ long, 279-R ..... .50
Fisherman's Outboard Boat, 9′ 3″ or 11′ 6″ long, weighs 115 or 160 lb., for motors from 3 to 16 h.p.; can also be rowed, 344-345-R ..... .75
Motorboat-Rowboat, 13′ long, decked hull, for use with outboard or inboard drives, 147-R ..... .50
Outboard Racer, 10′ 4″ long, weighs 114 lb., for class "A" and "B" motors, 211-212-R ..... .75
Racing Sailboat BLACKCAT, 13′ 4″ long, weighs 250 lb., Marconi rigged, 321-322-323-R 1.00
Sailboat, 12′ long, weighs 200 lb.; has fast skimming-dish hull, 314-R ..... .50
Sectional Rowboat, 9′ 8″ long, weighs 60 lb., all-wood construction; can be used with small outboard motor, 340-341-R ..... .75

FURNITURE

Combination Magazine Rack and Foot Rest; also Paper-Napkin Holder and Key Rack, 364A ..... .25
Double-Decker Bed, 277A ..... .25
Early American Round-Top Stand, 191A ..... .50
Fireside Bench, Colonial, 187A-188A ..... .50
Flat Top Desk, 2′ 2″ by 4′ 2″ top (no turning), 20 ..... .25

(Continued on page 222)

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2. SAVE GAS - MOBILOIL ENDS COSTLY "OIL DRAG" - PISTONS WORK SMOOTHLY - MAY SAVE 7% FUEL!
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RESULT: See the blackboard above. *Mobiloil saves you money 4 ways!* Socony-Vacuum Oil Co., Inc.

MOBILOIL *For Balanced Protection*

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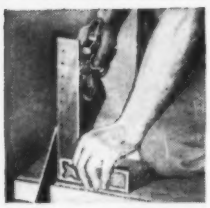
Also Disston D-8, "The Saw Most Carpenters Use." Skew back, 26" length . . . $3.50
Also KEYSTONE made by DISSTON saws, 26" cross-cut $1.00 up; Rip $1.50 up

These prices apply only to United States; for others, write Henry Disston & Sons, Ltd., Toronto, Canada.

and the Hint of the Month



To make a perfectly square end cut is easy, when the face of the board is marked square and a Disston try square used, as illustrated, to keep the saw in a vertical position.

AND NEW EDITION

FREE BOOK

Disston Saw, Tool and File Manual, radically revised. How to set and file saws. How to choose and use saws and tools. Many home workshop hints like one above, in its 48 pages of text and profuse illustrations.

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Remember Hardware Week May 6-13

Please send me FREE copy of the new Disston Saw, Tool and File Manual.

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Plans for Your Workshop

(Continued from page 220)

Floor Lamp, with tripod base, 243A	.25
Four-Leaf Card or Occasional Table, 239A	.25
Hanging Wall Cabinet, 9½" by 24" by 41¾", 280A	.25
Magazine Rack, ladder-back style, 250A	.25
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Silverware Chest on Stand, 256A	.25
Smoking Stand, modern, 238A	.25
Tea Wagon, with removable tray and drop leaves, 20" by 30" top (turning), 13	.25
Upholstered Stool, 240A	.25

MODELS

BLUENOSE, famous fishing schooner, 17½" hull, 110-111-112-R	1.00
Civil War Ships MONITOR, MERRIMAC, and HARTFORD, water-line models 3½", 5⅜", and 5⅛" long respectively, 258	.25
Clipper Ship GREAT REPUBLIC, 31½" hull, 272-273-274-R	1.25
Clipper Ship SEA WITCH, 9½" hull, 21[illegible]	.25
Coast Guard Patrol of 165-ft. Type, 20⅝" hull, 286-287-R	.75
Concord Stagecoach DIAMOND TALLY-HO, 20½" long, 115-116-117-R	1.00
Confederate Raider ALABAMA, 21½" hull, 335-336-337-R	1.50
Elizabethan Galleon REVENGE, 21" hull, 206-207-208-209	1.00
Fishing Schooner WE'RE HERE of "Captains Courageous," 9½" over all, 351-R	.50
Gettysburg Cannon, 11⅝" long, 292A-293A	.75
H. M. S. BOUNTY, 8½" hull, 254	.25
Liner NORMANDIE, 20⅝" hull, 264-265	.50
Liner QUEEN MARY, 10¼" hull, 283	.25
Locomotive Hudson type, HO gauge, 14" long, driven by 6-volt motor, 329-330-R	.75
NOURMAHAL, power yacht, 8⅛" hull, 276	.25
Ocean Freighter, 14" hull, 271	.25

(Construction kits are available for some of these models. Turn to page 224.)

RADIO

All-Wave Portable Receiver, 2 tubes, battery operated, 217-R	.50
Amateur Short Wave Receiver, 3 tubes, battery or 110-volt A.C. or D.C. operation, 155	.25
Beginner's Battery Receiver, 365A	.25
Full Electric Headphone Receiver (can be made compact for portable use), 130	.25
One-Tube Receiver, battery operated, 103	.25
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Home Workshop Index for 1937	.10
Home Workshop Index for 1938	.10
How to Build and Operate an Inexpensive Arc Welder and Spot Welder	.50
How to Make Your Own Marionettes	.50
Resilvering Mirrors at Home (leaflet)	.10
Workbenches and Tool Cabinets (leaflet)	.10

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Now a Quick and Easy Shaving

Gillette Blade at ½ Price

The new Thin Gillette Blade has edges of an improved type, hard enough to cut glass

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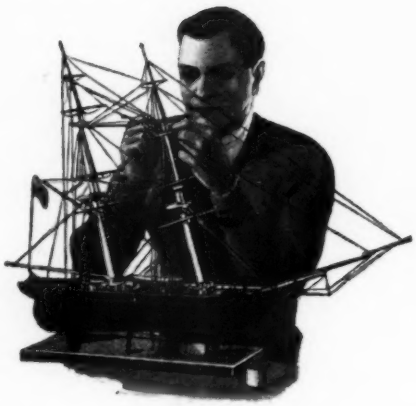
5 for 25¢



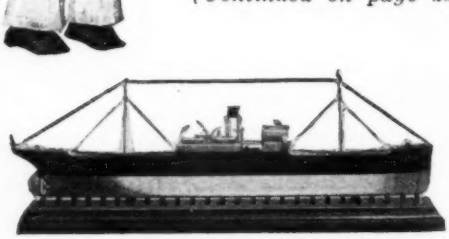
YOU CAN LEARN Model Making WITH OUR CONSTRUCTION KITS

BECAUSE it is difficult to obtain many of the odds and ends that are required for building a model, we have prepared a variety of construction kits containing everything in the way of raw materials. Complete instructions and blueprints are included, so you may easily learn this fascinating hobby.

Pictured above is the beautiful brig *Malek Adhel*, which is built with Kit 6S ($9.75+). The model is 33″ over all and has a hull of frame-and-plank construction. Finished blocks, deadeyes, belaying pins, thimbles, hearts, and anchors are contained in the kit.

For the person desiring a simpler model, there is the ocean freighter shown below. It is made with Kit 2M ($1.50) and is 14″ long.

Three kits are available for whittlers: Kit 7 ($1.50), a sea captain, illustrated at left; Kit 8 ($1.00), six different Scotties; and Kit 10 ($1.50), *(Continued on page 226)*



Kit 2M contains materials for building an ocean freighter. The figure above is made with Kit 7

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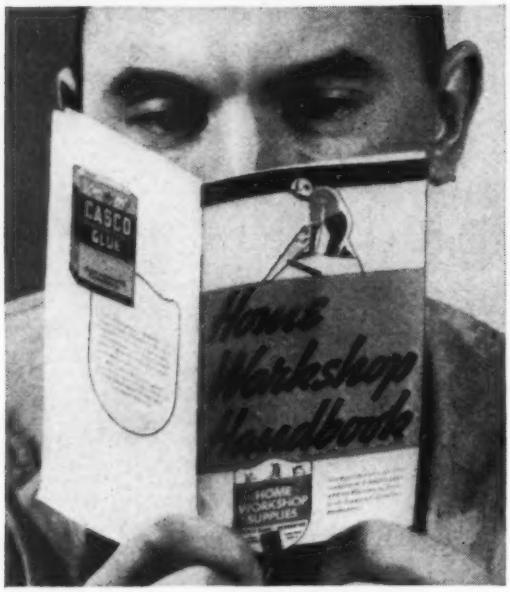

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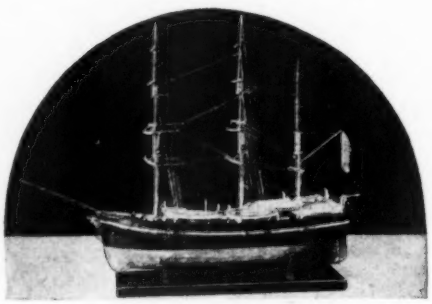
Kits for Model Makers

(Continued from page 224)

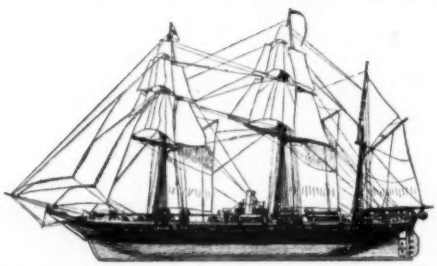


Kit A—whaling ship "Wanderer," 27½" over all

Hobo Hank. The latter contains a composition model, which you can easily copy.

Among our standard kits, the whaling ship *Wanderer,* above, has always been a favorite. The model is 27½" over all with a 20½" hull, and is made with Kit A ($7.40*). The newest ship in our list is the Confederate raider *Alabama,* below, constructed with Kit 10S ($8.20*). It is 28" over all and has a 21½" hull.

A complete list of our kits appeared on page 238 of the March issue. An illustrated leaflet describing the kits will be sent free upon receipt of a large, stamped envelope.



Confederate raider "Alabama" made with Kit 10S. The model is 28" over all and has a 21½" hull

Note: If you live west of the Mississippi River or in Canada, add 50 cents to prices marked with an asterisk (*) and 25 cents to price marked with a dagger (†).

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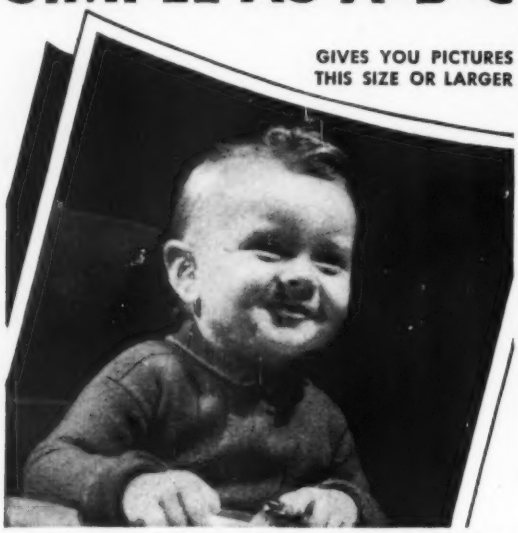

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Individual Films Developed by Using Test Tubes

OWNERS of film-pack and cut-film cameras, who have occasion to develop one film at a time, can do so economically and conveniently by using three test tubes of the proper diameter, mounted in a rack as shown. The first tube is empty and *dry;* the second, filled with short-stop hardener solution; and the third, with the hypo fixing bath. Developer is prepared on the side in a graduate and should be the same as for tank development. In most cases, one ounce of solution is sufficient to fill a test tube.

To develop a film, it is rolled, emulsion side in, and inserted into the first test tube. Be careful that the ends do not overlap. The developer is then poured into the tube and left for the proper time. A light-tight cardboard box can be inverted over the rack to exclude light while developing is going on.

When the time is up, the developer is poured out and the short stop poured in. This is followed by the hypo. If the back of the film adheres to the test tube, a long slender rod such as a bone knitting needle will loosen it during fixation. When finished, it can be removed from the test tube by gripping it with a pair of forceps in the middle of the upper margin.

Test tubes for films up to 2¼" widths should be 1" in diameter; for 3¼" by 4¼" films, 1¼"; for 4" by 5" films, 1½". In the case of orthochromatic film, inspection under a red light is a simple matter when tubes are used.—LOUIS HOCHMAN.

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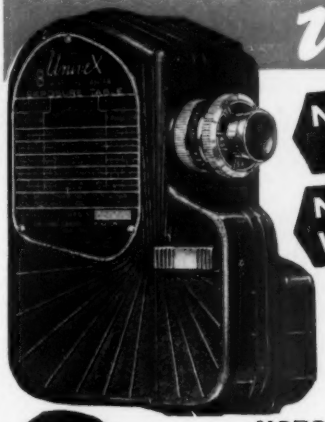

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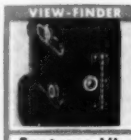

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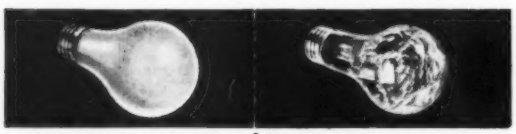
To be sure of better pictures, be sure your photo lamps are "G-E"



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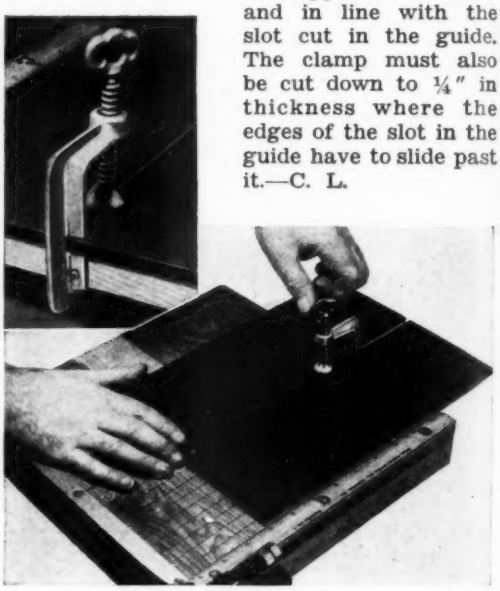
CUTTING sensitive film or paper on a paper trimmer in the dark is delicate work. Although such simple guides as push pins will serve, more accuracy and speed may be had by using the guide illustrated. First cut a piece of tempered composition wood or similar hard material to a size but slightly smaller than the bed of the trimmer. Cut a ¼" slot from one edge almost to the other edge. An ordinary C-clamp is then drilled so that it can be screwed to the edge of the bed, opposite the knife and in line with the slot cut in the guide. The clamp must also be cut down to ¼" in thickness where the edges of the slot in the guide have to slide past it.—C. L.



The sliding guide is locked with a C-clamp. Note in upper view how the back of the clamp is notched

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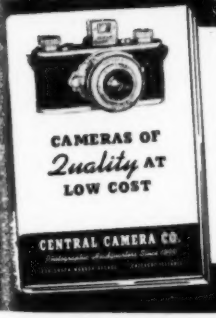

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Captain Kidd's Gold?

(Continued from page 58)

chips that showed it was made of spruce. Then, it dropped twelve inches and began boring through four inches of solid oak. Beyond the oak, it passed through twenty-two inches of what appeared to be loose metal—which the treasure seekers were sure was golden coins. Biting through eight more inches of oak, the drill penetrated another twenty-two inches of loose metal and another four inches of oak. Then, it went on through seven feet of clay, and the drilling stopped.

MOVING his apparatus over a few feet, the operator began again. As before, the auger passed through the platform at 100 feet. Below, it started revolving unevenly, bringing up splintered chips that seemed to have been gouged from the bulging side of a heavy oak cask. Spurred on by this proof that something lay at the foot of the drowned shaft, the company began a frenzied effort to drain the pit. Great pumps, driven by relays of draft horses brought from the mainland, operated night and day. Enormous quantities of water were drained away. Yet the level in the shaft remained the same.

They then discovered that they were, in effect, trying to bail out the sea. The water was salty and the level in the pit rose and fell with the tides. In some mysterious way, the pit was connected with the ocean water around the island.

Tests made last year on the island indicate that the flow of sea water into the pit is approximately 500 gallons a minute. The powerful electric pumps which will be tried out a few months hence will have a capacity of at least 1,000 gallons a minute.

Unable to drain the shaft, the 1849 company was ready to give up when some of the men noticed a curious thing about a small cove some thirty rods south of the money pit. For hours after the tide receded, the curving stretch of beach gushed forth water in large rivulets almost as though it were a sponge being squeezed.

Digging into the sand at the cove, workmen came upon a layer of the same fibrous material discovered in the money pit, then a layer of eelgrass, then large and small bowlders arranged in a peculiar manner. In later years, some of the fibers were submitted to scientists at the Smithsonian Institution, in Washington, D. C. I have seen the report they made. The fibers, they declared, had come from coconuts and, buried under the conditions in which they were found, might have remained intact for centuries.

For more than 140 feet along the beach, the workers of eighty-nine years ago excavated to a depth of eight feet. Everywhere, they found the same thing. Beneath about three feet of sand, they came to a thick layer of coconut fibers. Underneath it was a heavy matting of decaying eelgrass. Tons of the tropical coconut fibers were removed from the beach of the northern island and piled in stacks like haycocks along the shore. Nowhere in the region, except at the cove and in the money pit, were the fibers ever encountered. Another strange happening occurred when oxen, plowing a near-by field, plunged fifteen feet into the earth when the ground caved in under their feet.

Beneath the matting on the beach were bowlders, large and small, so placed that there were countless interstices between them. Some one, long before, had excavated the beach and turned it into a vast and cunningly devised sponge hidden beneath three feet of ocean sand. Every incoming tide, creeping up the beach, filled the crevices with water. Who had designed and built this reservoir of ocean brine, and why?

The latter half of that question was soon answered. Converging like the ribs of a great fan, five long gutters were discovered cutting through the maze of bowlders. Each was formed of flat stones laid end to end, in the manner in which early farmers, before the introduction of drainage tiles, sometimes reënforced their ditches. All these gutters, the diggers found, met at what appeared to be the outer end of an underground channel, a crude sort of conduit slanting downward toward the money pit. Thus, the whole elaborate scheme seemed clear. The man-made sponge, replenished daily by the tide, provided a constant head of water which prevented the pit from being drained.

BUT who was its mysterious builder? Who had buried the wooden platforms in the earth? How had tons of tropical fibers reached the shore of an uninhabited Nova Scotia island? And what lay secreted at the bottom of the money pit, guarded so effectively by the water of the sea?

With those questions still unanswered, the company which began work in 1849 also exhausted its funds and ceased operations. Grass and rust once again held sway over the scene of its feverish activity. But other treasure seekers were to come. The amazing discoveries they made and the chapters they added to the mystery story of Oak Island and its buried treasure will be related in next month's article of this series.

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Vacu-matic is *entirely different!* It operates on the supercharge principle by automatically adding a charge of extra oxygen, drawn free from the outer air, into the heart of the gas mixture. It is entirely automatic and allows the motor to "breathe" at the correct time, opening and closing *automatically* as required to save dollars on gas costs.

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The distance covered was 2322 miles in thirty-nine hours and forty-two minutes, officially timed by Western Union, which gave me an average speed of 59.7 M.P.H. based on elapsed time and with the Vacu-matic averaged 18-1/2 miles per gallon on gasoline.

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Yours very truly,

In addition to establishing new mileage records on cars in all sections of the country, the Vacu-matic has proven itself on thousands of road tests and on dynamometer tests which duplicate road conditions and record accurate mileage and horse power increases.

You, too, can make a road test with Vacu-matic on your car and prove its worthwhile gas savings to your entire satisfaction.

Learn all about this remarkable discovery. Get the facts NOW!

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This certifies that I have carefully read 300 original letters received from Vacu-matic users testifying to gas savings up to 30%, many reporting added power, smoother running, and quicker pick-up. These letters are just a small part of the larger file of enthusiastic user letters that I saw at the company offices.

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Why Nobody Can Steal Your Invention

(Continued from page 88)

showed little if any idea of what it was all about, beyond his evident conviction that it was something valuable. The Patent Office had no difficulty in awarding the patent.

Even if a patent has already been issued to another inventor, you can still challenge his right to it. You are entitled to demand a trial to determine whether you or he made the invention first. If you can prove that you did, the patent will be reawarded to you.

What about the possibility of influencing any patent dispute by false testimony? Any witness who deliberately lies when he testifies in a patent case commits the crime of perjury. An opponent who believes that perjury has been committed may call upon the Department of Justice for criminal prosecution. Patent Office personnel have standing orders to keep constantly alert for any such cases, and their specialized training would make it difficult indeed for any perjurer to escape detection and punishment.

In virtually all the interference cases that actually arise, however, there is no question of "stealing" an idea. The chances are overwhelming that anyone who claims the same invention as yours has simply made it legitimately and independently, and has never heard of you or your work. There are celebrated examples of amazing coincidences in the field of invention. Photography was invented in the same year by workers on opposite sides of the Atlantic. Three inventors, unknown to each other, almost simultaneously discovered how to produce aluminum. No less than seven inventors, including Alexander Graham Bell, Thomas A. Edison, Elisha Gray, and Daniel Drawbaugh, came forward practically at once with the telephone! Then, as in all such cases, the problem was to determine who invented it first.

Cases like these emphasize the importance of keeping proper records of your invention—not only so that no one can "steal" it, but also to enable you to prove, if possible, that you are the first of several inventors who devised the same thing independently.

What may happen to an oversecretive inventor is illustrated by an experience of Miller Reese Hutchison—formerly Thomas A. Edison's chief engineer, and credited with more than 300 patents. As a youth, he relates, he invented the electric train intercontrol system now used extensively on subway trains. Someone had told him to keep his inventions secret. So he explained his idea to no one, and even failed to have his draw-

Why Nobody Can Steal Your Invention

(Continued from page 234)

ings dated and witnessed, lest some one "steal his invention." In due time he applied for a patent. A little later, Frank K. Sprague, now known as "the father of electric traction," applied for a patent on the same system. The Patent Office placed the two applications in interference, and called upon the two inventors to state their cases. Sprague was able to offer evidence that he had conceived the idea some time before the date of either patent application. Hutchison maintained that he had made the invention still earlier, but he had not a shred of proof to back it up. Naturally his claim for a patent was denied.

Just what should you do, then, when you make an invention? My advice would be to select a few people of high character and explain it to them. Make sure that they understand it thoroughly, for you may need to have them explain it, as witnesses, later on. Have them date and initial the drawings or model that you have made, also for possible future use as evidence. To make your case as airtight as possible, do the same with all later drawings or models, embodying improvements you have worked out in your invention. These will give your claim additional weight, showing you have carried out the spirit of the patent law by making good use of the time allowed for perfecting an invention before applying for a patent.

Inventors have devised various other ways to safeguard their proof of priority, always with the possibility of an interference in mind. Miller Reese Hutchison, having been burned once in his contest with Sprague, now makes assurance triply sure. Three copies are made of all his drawings. He sends one set to his attorney and one to himself, both by registered mail. When the postman brings him his own, he keeps it unopened, with the date officially stamped on it for evidence. The third set of drawings serves him for routine work. But the law does not require this, nor specify any particular method of proof, simply leaving it up to the inventor to be prepared to show in any convincing way when he made his invention.

While this will fully protect your rights during the two-year period allowed by the law, it still is advisable to delay applying for a patent no longer than necessary. There is a practical reason. *Until evidence convinces it otherwise,* the Patent Office assumes inventions were made in the order that applications were filed. This does not contradict the principle that a patent belongs to

(Continued on page 236)

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Why Nobody Can Steal Your Invention

(Continued from page 235)

the first inventor, irrespective of who applied first. But it does mean that the later or "junior" applicant must shoulder the burden at his own expense of proving his claims, and thus puts a premium upon making a patent application promptly.

Also, while it is wise to tell a few reputable people all about your invention, that doesn't mean that your best policy is to pour out its details to every Tom, Dick, and Harry that you meet. Among a large number of people, some one might conceivably be tempted to copy your invention and file a conflicting claim, and then you would have to defend your own in an interference proceeding. You could certainly beat him if your records are in order, but why let yourself be put needlessly to the trouble? Simply use the same common sense in choosing the people you take into your confidence as you would in a real-estate transaction or any other business deal, and you will avoid any such difficulty. A few reliable witnesses will serve as well as dozens. One of Bell's opponents in the telephone case, Daniel Drawbaugh, offered more than fifty witnesses to support his claim, but their testimony was so conflicting that it carried no weight.

Just what is your risk of becoming involved in an interference proceeding, from any cause? Up to the present, there have been about 76,000 conflicts of this kind at the Patent Office. In 1937 there were 1,494 interferences involving about 4,000 applicants. Considering the number of unopposed patent claims, this seems small indeed. On the average, only one out of forty or fifty applicants finds an opponent claiming the same invention.

In certain active fields of invention, the chances of an interference may rise to one in fifteen, one in ten, or even more. The famous chemist, Carleton Ellis, who has patented more than 700 inventions, says that one out of every six or eight applications he files at the Patent Office encounters an interference. This is because much of Ellis's work relates to the highly competitive petroleum industry. Every big oil company keeps a research staff constantly working to solve widely known problems. It is only a matter of time before each company will turn out the needed invention.

Though an interference proceeding usually involves only two or three contestants, half a dozen or more inventors sometimes file conflicting claims. Before William S. Gubelman received a patent for his calculating or

Why Nobody Can Steal Your Invention

(Continued from page 236)

adding machine, he encountered no less than 184 other inventors claiming the same invention in whole or in part! One contributing cause probably was the length of time his patent application remained pending. Another was the amazing number of parts in his device. Many of the parts were really inventions in themselves, so that the chances were correspondingly increased of duplicating the ideas constantly occurring to independent inventors.

Sometimes interference cases occur between brothers, or between a father and son, and quite frequently between employer and employee. In the latter case, the question for the Patent Office to decide is usually one of originality—that is, which claimant copied the idea from the other. Commonly, in other cases, however, it becomes clear that each of the claimants made the invention independently, and the question to decide is who did it first.

It takes only a few months for the Patent Office to settle who is entitled to a disputed invention, in the ordinary run of cases. If the invention is of tremendous importance, however, and the decision is appealed to the courts, the legal wrangling may go on for years. The contest between Lee De Forest and Major Edwin H. Armstrong over the invention of the regenerative, or feed-back, radio circuit lasted twenty-one years. Twice De Forest had to carry his claim of priority to the U. S. Supreme Court. Reviewing all the evidence from both sides, in 1934, the Supreme Court quoted from De Forest's daily notebook the significant entry, "This day I got the long-looked-for beat note." That passage, said Justice Cardozo in speaking for the court, referred to the "true superheterodyne beat note." It marked the completion of De Forest's invention and won him a $1,000,000 patent.

No matter which party gets the benefit of the Patent Office's decision, there probably will be some one who will contend it has erred. To many people, for example, the man who sells the public on an idea is the inventor. In the eyes of the Patent Office, however, the real inventor is the first man to complete working drawings or a model.

To sum it all up, it is well-nigh impossible for anybody to steal your invention. There is no warrant for the absurd secrecy that so many people associate with inventions. All an inventor need do is to handle his creations with the same common-sense discretion that he would use in ordinary business affairs.

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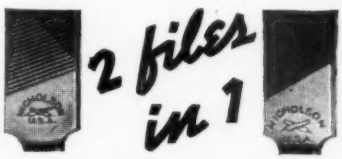

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An Idea and a River Brought Him Wealth

(Continued from page 81)

received that Rodenhiser took some of his hard-earned income and bought an emergency Diesel generator. Ironically, since he installed the new generator the water level has been ideal and he hasn't used the fancy outfit even once, but it will be there if the need ever arises again.

Today his monthly gross averages $250, and he can look forward to a future of gradual expansion. It has been estimated that his plant, his dams and wire and poles and meters and other equipment, may be valued at $30,000. On a hill with an almost endless view stands his home—a far cry from the shack in the woods where he lived at the start. Instead of traveling afoot to interview subscribers and make emergency repairs to his power lines, he whizzes around in a new automobile.

Yet Leonard Rodenhiser is still the same simple man who came to Sherbrooke in 1931 with only an idea. He is probably the only president of a utility company who can be telephoned by a subscriber and bawled out for poor service. Almost any day he may be found digging post holes, stringing wire, making installations in the homes of new subscribers, or doing any one of the dozens of jobs that face a one-man organization.

To those who say the spirit of pioneering in industry is dead, and to those overwhelmed by the vast financial organizations that are the utility companies of today, he offers hope. Wherever there is water power, and an idea combined with ability, there, he says, can grow a one-man utility company. But he never fails to add: *Don't* forget the franchise.

POPULAR SCIENCE Question Bee

HERE are the answers to the Question Bee on page 136. In the list below, letters indicate the correct solutions to the numbered questions. Check your own list against it, and give yourself five points for every one that you got right. A total score of 75 to 85 points is good; 90 or better is excellent.

1. c	5. b	9. b	13. d	17. c
2. b	6. c	10. b	14. c	18. b
3. b	7. d	11. d	15. c	19. d
4. a	8. a	12. d	16. b	20. b

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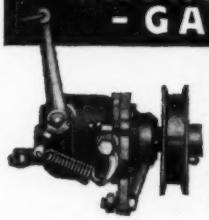

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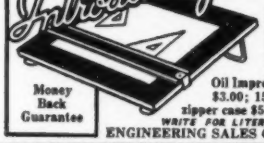

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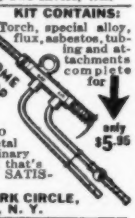
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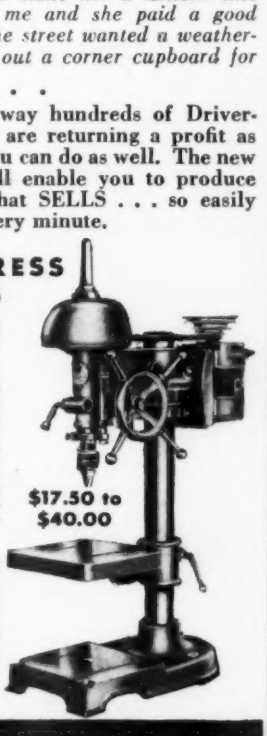

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Gus Makes a Vacuum Tester

(Continued from page 142)

retor and the manifold. If you find that that isn't the trouble, look for a cracked or broken intake-valve spring.

"With the engine idling and the mercury column up to twenty inches, speed up suddenly. The mercury column should at once drop to five inches, and stay there. If it doesn't stay there, but fluctuates up and down, the valve springs are weak.

"Speed up the engine and watch the quicksilver as you let go the throttle, so that the engine drops back to idling speed quickly. If an engine is in really good condition, it will pull the mercury column up to twenty-five inches, momentarily. If your engine doesn't do that, you'd better have a look at the piston rings.

"Using poor oil, or the improper grade, sometimes has the same effect as worn rings, but the odds are at least ten to one against the oil being the cause of the trouble.

"If, when the engine is idling, there is a sudden heavy drop in the mercury column, it's a sign of a blown gasket between cylinders. You can tell which cylinders, by holding a screw driver against each plug—one at a time—and noting which cylinder fires as the mercury column drops. If you have a blown head gasket, the only sensible thing to do is to have it replaced at once.

"If the trouble shooter indicates that your engine is in good condition, but your car bucks when you are running at low speed on the road, don't cuss the trouble shooter—or me. Take a look at your windshield wiper and its hose, and at your spark coil. Any one of the three may be causing the bucking.

"Well, the trouble shooter is yours, Doc. I hope you have as much fun using it as I had making it."

"I will, Gus—you can bet on that," Dr. Marvin said. "And thanks for making it for me. But how much do I owe you for materials?"

"Well, now, let's see," Gus said, beginning to jot down figures. "The backboard came out of a packing case, so it didn't cost anything. The yardstick's with the compliments of Henry Miller. The druggist charged me thirty-five cents for the mercury, and two cents for the rubber bottle stopper. The glass tube cost fifteen cents, and the rubber tubing twenty cents. That adds up to seventy-two cents, doesn't it? Told you the gadget would set you back less than a dollar! And you'll get many a dollar's worth of fun and service out of it. Next time your engine acts up, just pretend it's a sick baby and try out your vacuum-tester stethoscope on it!"

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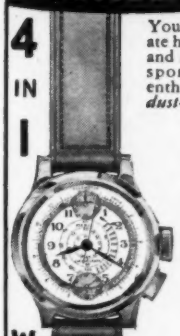

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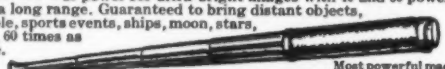

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Reconditioning an Old Microscope

(Continued from page 207)

precipitate has settled, and decant off the clear liquid. Add more water, preferably warm, and let stand for another hour or longer. Decant again. By repeating this several times, you can wash the precipitate to free it of soluble chemicals.

Clean brass parts thoroughly with soap and water, and polish if necessary. Remove every trace of grease by scrubbing, boiling in lye water, or washing with carbon tetrachloride or other grease solvent. Handle the parts with tweezers or pliers after cleaning. Heat the copper carbonate bath to about 150 degrees F., and immerse the brass pieces in it until sufficiently darkened. This will require a number of minutes. Remove the pieces, wash thoroughly, and dry with a cloth. This oxidized coating will last a long time, and can be protected further by applying clear lacquer.

In this way you can refinish the parts of a microscope that require it. Check the various working parts, such as focusing screws, substage mirror and slide clips, and repair or replace them if necessary. You can replace a broken mirror with a new one, altering the mounting to fit, if necessary. If the mirror silvering is bad but the glass sound, you can have it resilvered, or do the job yourself.

After all parts have been refinished and otherwise tuned up, reassemble the microscope carefully, and adjust the focusing mechanism and other working parts until they function smoothly. Petroleum jelly can be used to lubricate focusing screws and other machine parts.

Many of the older instruments will not accommodate modern objectives and eyepieces. It is not, in most cases, a difficult matter to alter the body tube so that it will accommodate standard oculars. This may require cutting off the upper part of the tube and soldering to it a length of brass tubing into which a 23-mm.-diameter eyepiece will fit without binding. Providing for the use of objectives having Society threads is generally something a bit more involved, for the lower end of the tube (the nose) has to be equipped with female threads of the proper size; and these have to be cut accurately as to alignment and centering. Often a threaded bushing is all that is required to fit the objective to the existing threads.

Reconditioning an old microscope is a lot of fun. Besides, it is the best possible way of learning how to repair and care for your regular instrument.

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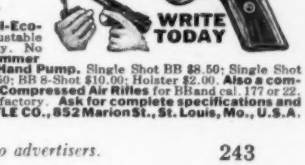

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Fun with Quicksilver

(Continued from page 203)

glass chemical funnel. Then place the funnel in the top of a burette with a capacity of fifty to 100 cubic centimeters (or two or three fluid ounces) filled with a ten-percent solution of nitric acid. This may be made by adding about ninety cubic centimeters (three fluid ounces) of water to ten cubic centimeters of strong nitric acid. The silk cloth on the funnel should dip into the acid at the top of the burette. To purify the mercury, pour it into the funnel in five or ten-cubic-centimeter portions. The quicksilver will pass through the cloth and enter the nitric acid in a fine, foglike stream. The acid attacks and dissolves the baser metals, but does not affect the mercury falling through the liquid column. The purified mercury may be drained off at the bottom of the burette and passed through the acid once more for good measure. Then the burette is emptied of acid, thoroughly washed, and filled with fresh water; and the mercury is passed through it again to wash off any nitric acid.

Since mercury vaporizes almost as easily as water at high temperatures, and the vapor is poisonous, the metal should not be heated in home experiments. Even at room temperature, mercury gives off some vapor. However, droplets of mercury that have spilled from your chemical workbench soon become coated with a film of grease and scum that prevents them from becoming a health hazard.

To prevent the valuable metal from going to waste, you will still want to recover as many spilled droplets as you can. A convenient aid is a little homemade device that might be called a "mercury picker-upper." A small, wide-mouthed bottle of about one-ounce capacity, with its bottom cut off, is closed at each end with a one-hole stopper. One of the corks carries a medicine dropper whose stem, with the bulb removed, extends about half an inch into the bottle. The other cork carries a straight glass tube with a closed end and a small hole in its side. To make this fitting, seal the end of the tube in the Bunsen flame; heat the side wall, preferably with the pointed flame of a mouth blowpipe; blow into the tubing to puncture the softened glass; and smooth the rough edges by fusing them in a flame.

With a piece of rubber tubing attached to this fitting, the "picker-upper" is ready for use. Spear a drop of mercury with the tip of the medicine dropper, and suck on the rubber tubing. The mercury will obediently hop up the medicine dropper and fall into the bottle. The closed end of the upper tube prevents the droplet from being sucked into the mouth.